ANALOG

SCIENCE FICTION AND FACT

JUNE 2008

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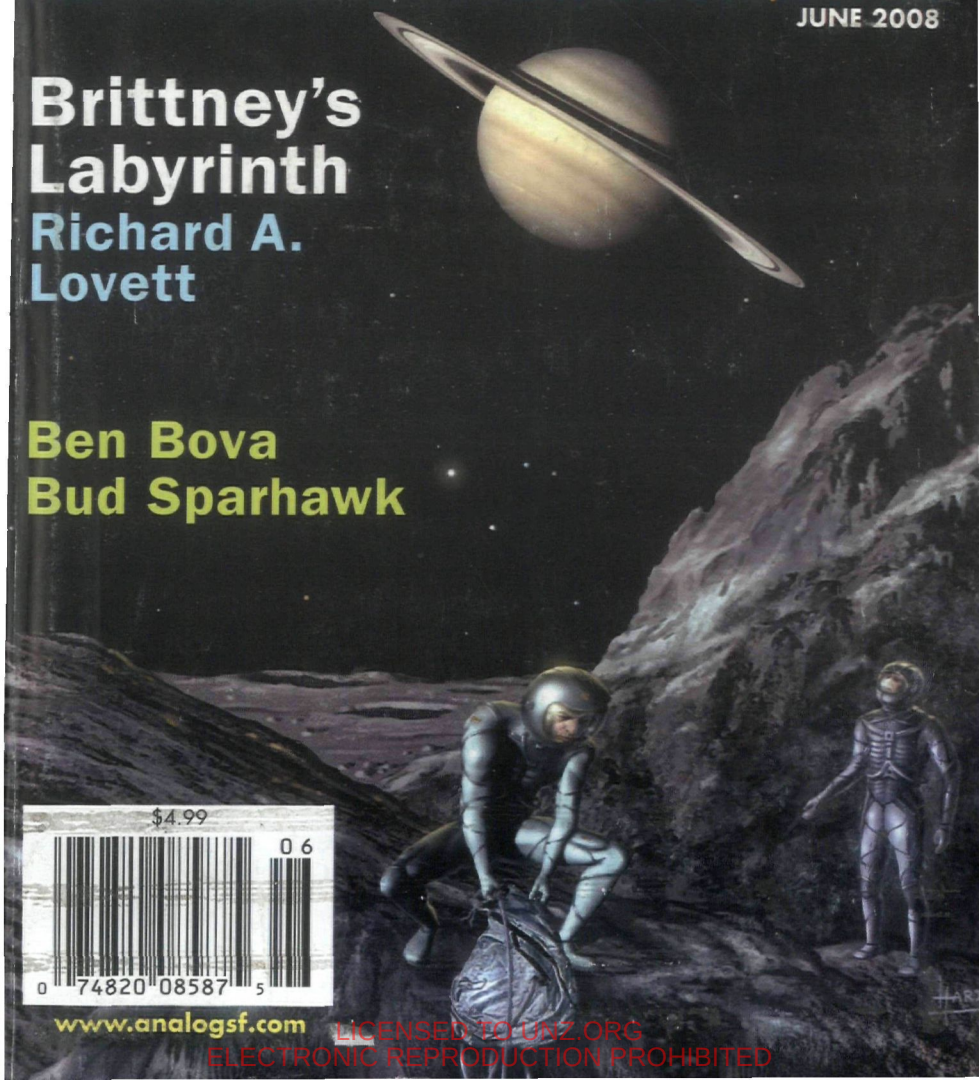

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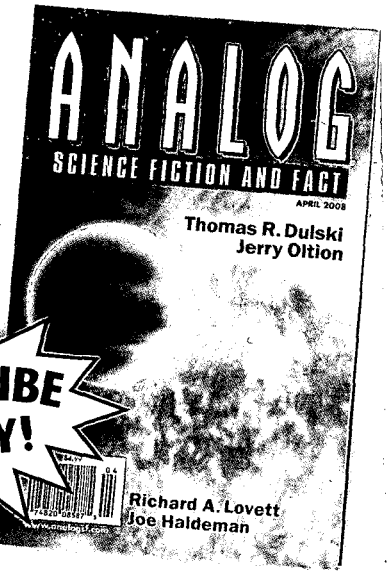

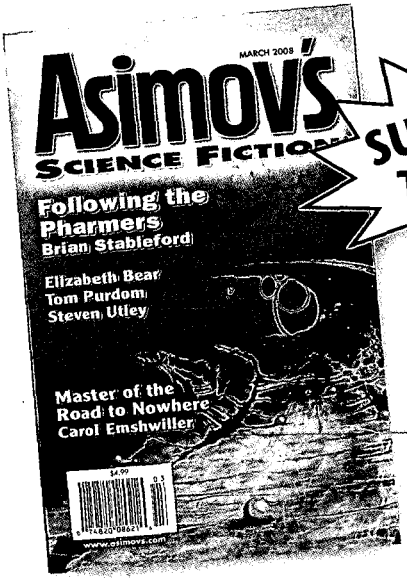

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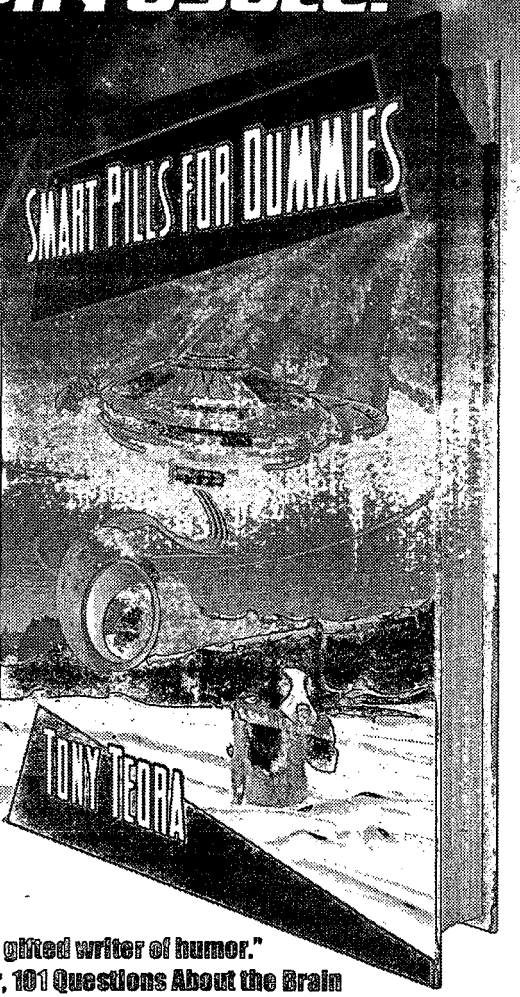

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SCIENCE FICTION AND FACT

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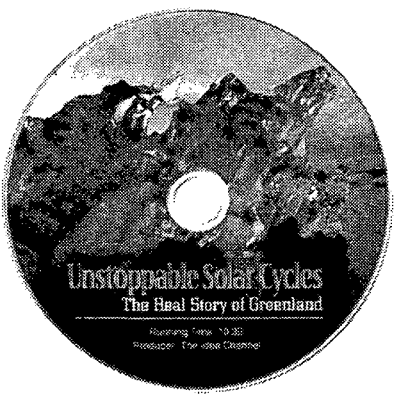
An alternate view

Global Warming:
Is it *science* or science *fiction?*

The scientific community agrees that the world's climate is changing, but disagrees over why it is changing, how much it will change, and whether the consequences of change will be good or bad.



The theory that the Modern Warming is man-made and will be harmful dominates the mainstream media's coverage of climate change. Politicians compete to promise the biggest reduction in greenhouse gas emissions (80% by 2020? Sure, why not?).

But is it true? Cutting energy consumption would slow economic growth and job creation and stifle the technological innovation that holds the key to prosperity for billions of people in the 21st Century. What if the modern warming is natural and moderate? What if emission reductions aren't necessary after all?

Think about it. Talk to your friends and neighbors. Tell them the truth: **Global warming is not a crisis.**

For more information about global warming, request a free 10-minute video on DVD titled *Unstoppable Solar Cycles: The Real Story of Greenland* by calling 312/377-4000 or send an email titled *Unstoppable Solar Cycles* to think@heartland.org with your name and mailing address. This ad is sponsored by The Heartland Institute, an independent nonprofit research organization. For more information about us, visit **www.heartland.org**.

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EDITORIAL Stanley Schmidt

OUR MOST IMPORTANT PRODUCT

When I was growing up, I heard and saw a great many ads for General Electric featuring the slogan, "Progress is our most important product." A reasonable case could be made that, in at least one sense, it really was, though of course "importance" can be measured in a variety of ways. Often "most important product" is taken to mean a physical commodity with large economic importance to an area, or that is strongly associated with that area because more of it is produced there than elsewhere. Lobster from Maine, for example, or maple syrup from Vermont, or software from Silicon Valley.

But what is the most important product of American business as a whole? Writing this in the height of the holiday gift-hawking season, I find myself irresistibly tempted to make an irreverent suggestion: the most important manufactured product in the contemporary U.S. is "need."

How often have you heard a child—or adult—say they "need" this or that because it's the latest fad? How many garments, games, or gizmos have you heard advertised or reviewed as "this season's must-have"?

I know; I've lost count, too.

It's time for a reminder and a reality check. In the strictest sense, there are extremely few "must-haves." Air, water, and food—all of which are aspects of "usable energy"—are (at least in our present condition) hard to dispute. Also, given that we have physical bodies, we need a quantity of space for them to occupy. There's not much else that's necessary for survival.

Most of us, of course, would not be satisfied with mere survival at its minimal level, but there will be times when we may have to settle for that—and be able to endure it—until we can work through hardships to something better.

To get beyond mere survival, and derive some satisfaction from life, most of us also have psychological needs such as companionship, approval from others, and self-esteem, though the level of dependence on these things varies widely from individual to individual. None of us, though, has a built-in *need* for a huge house, an SUV for city driving, *any* new car or computer every year or two, a multithousand-dollar dress to be worn once, or an electric card-shuffler.

So, in a society almost as geared as Aldous Huxley's *Brave New World* to viewing consumption as an intrinsic good, we've created an entire industry dedicated to making people *think* they need such things, whether they do or not. We've accustomed ourselves to following it like sheep wherever it chooses to lead us. And that, in turn, leads to a tremendous amount of waste of time, money, material resources, and human energy, making and trading objects to fill "needs" as artificial as the objects themselves. It leads also to a great deal of psychological stress among people who feel pressured to "keep up with the Joneses."

Wasting energy and resources, good

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as it might seem for the short-term health of an economy that has evolved to depend on it, can hardly be good for the long-term health of atmospheres and ecosystems. Constant, frenzied competition to have the "Latest and Greatest Everything" can hardly be good for the long-term mental health and viability of a society that has let itself be driven to such a state.

Please don't read this as a blanket indictment of advertising as an unmitigated evil. It isn't; both businesses and consumers need it. Businesses need to let potential customers know that their products and services exist and are worth having; consumers need to know where to find what they want. But please note how different the emphasis in these statements is from the ones commonly implicit (and sometimes explicit) in real-world advertising. I acknowledge the essential value of advertising as a means of enabling producers and consumers to find each other. I reject and resent the notion that it's a Good Thing for businesses to try to browbeat me into thinking I just *have* to have their product, instead of presenting me with information that leads me to make that decision (or not) for myself. I've often wished that good but short-lived restaurants had advertised enough to build a clientele that would ensure their viability. I've stayed away from car and furniture dealerships (no doubt you know examples) because their advertising was so in-my-face obnoxious I wanted nothing to do with them.

Of course, not all of the needs that are created and thrust upon us are entirely products of advertising. Given that very few of us would willingly settle for bare-minimum survival, we must acknowledge that anyone who wishes to live at all comfortably in any real-world civilization will need certain things, and those "second-order" needs change as technology evolves and society evolves with it. I don't need to look far afield for examples, or point a smug finger only at others comfortably remote from myself.

You're reading this in a magazine that is part of the publishing "system" that has grown up as a major means of disseminating information, ideas, and entertainment in this part of the world and this period of history. That system is in a state of unusually rapid flux at the moment, and how it works in ten years may be quite different from the way it works now. But we can already say confidently that the system has undergone big changes in the last few centuries, and especially in the last few decades.

One of those changes is that, in some respects, it's much easier for an aspiring writer to get his or her work in front of an audience than ever before. All that's necessary is to post it online and try to entice people—*any* people—to look at it, whereas formerly it would have been necessary to find an editor willing to

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publish it. The number of writers who could do that was necessarily small, and a very large percentage of writers—sometimes even genuinely talented ones—remained unknown wannabes.

In another sense, though, the recent evolution of computer technology and its application to publishing has made it harder—or at least more expensive—for a new writer to get started. Once you've written something, it's easier than ever to get it at least nominally published (though most online publication [with some conspicuous exceptions] produces little if any income for its authors). But taking that initial step, the act of writing itself, requires much more of an investment in equipment than it used to.

Shakespeare and Dickens wrote longhand with quill pens—and delivered their manuscripts that way. It's been a long time since any professional editor would have been willing to accept such a longhand submission. Most people's penmanship is so much harder to read than typescript that, once typewriters were widely available, it became *necessary* for any writer with professional aspirations to get one, even though it required a much more substantial investment than a pen. In the last couple of decades, it has become *almost* that necessary for an aspiring writer to have a computer and one or more peripherals such as printers, disk burners, and internet connections—which are even more expensive than typewriters.

The necessity is clear for a writer who wants to publish only online: the computer is the basic operating "cell" of the internet. But why should someone who wants to write for printed magazines or books "need" a computer? Quite simply, because it offers huge advantages over the typewriter to both author and publishers, and so many writers have already made the switch that publishers have reconfigured their in-house equipment and staffing to deal with material that will almost always be generated electronically. They are no longer equipped to handle significant amounts of material that isn't. When most writers wrote on typewriters, typesetting required somebody within the publishing company (or a subcontractor) to retype every entire manuscript. That meant people had to be employed to do that. Now, when most authors can provide electronic copies of their accepted manuscripts, and those can be used directly

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for typesetting, the retyping stage is no longer necessary and staff is no longer employed to do it. Some publishers already refuse to accept manuscripts that can't be supplied in electronic form; others will *occasionally* accept one that's typed, but it's a hardship and they can't do it very often.*

The new method has big advantages for writers as well as publishers. For example, in the old system, new mistakes often crept in during the retyping-to-typeset stage. That doesn't happen with that stage gone, so typesetting is generally more accurate when it's done directly from the author's disk. But it does mean that writers who want to operate within the new system have a genuine need for computers, which are more expensive than typewriters (which are more expensive than pens).

That's just one example of how evolving technologies and coevolving societies can create new needs that really *are* needs, at some level, and come with benefits that make it worthwhile to accept them. But we could use some practice, I think, at recognizing the difference between that kind of need and the kind we let ourselves be convinced exists only because somebody else tells us it does—because they want to sell us something. ■

* Please note carefully: This does *not* mean you can automatically now do *everything* electronically. Some publishers do accept electronic submissions (and are sometimes very particular about format). Others (including *Analog*) still require a hardcopy (accompanied by a self-addressed stamped reply envelope) for first reading, and want an electronic copy only after acceptance. It depends on how things are done in a particular office; as a writer, you'll need to find out the policy for each publisher you'll deal with.

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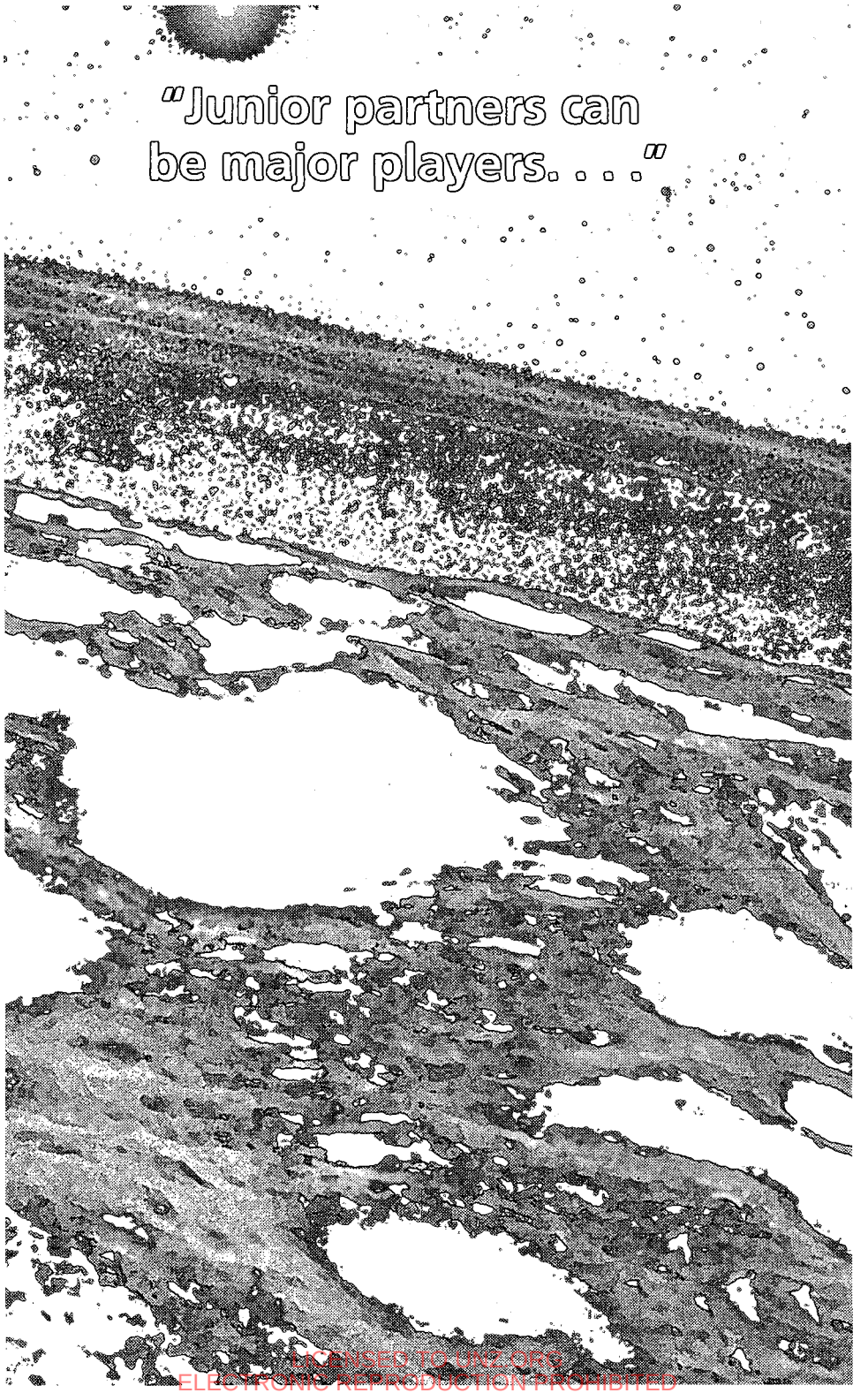

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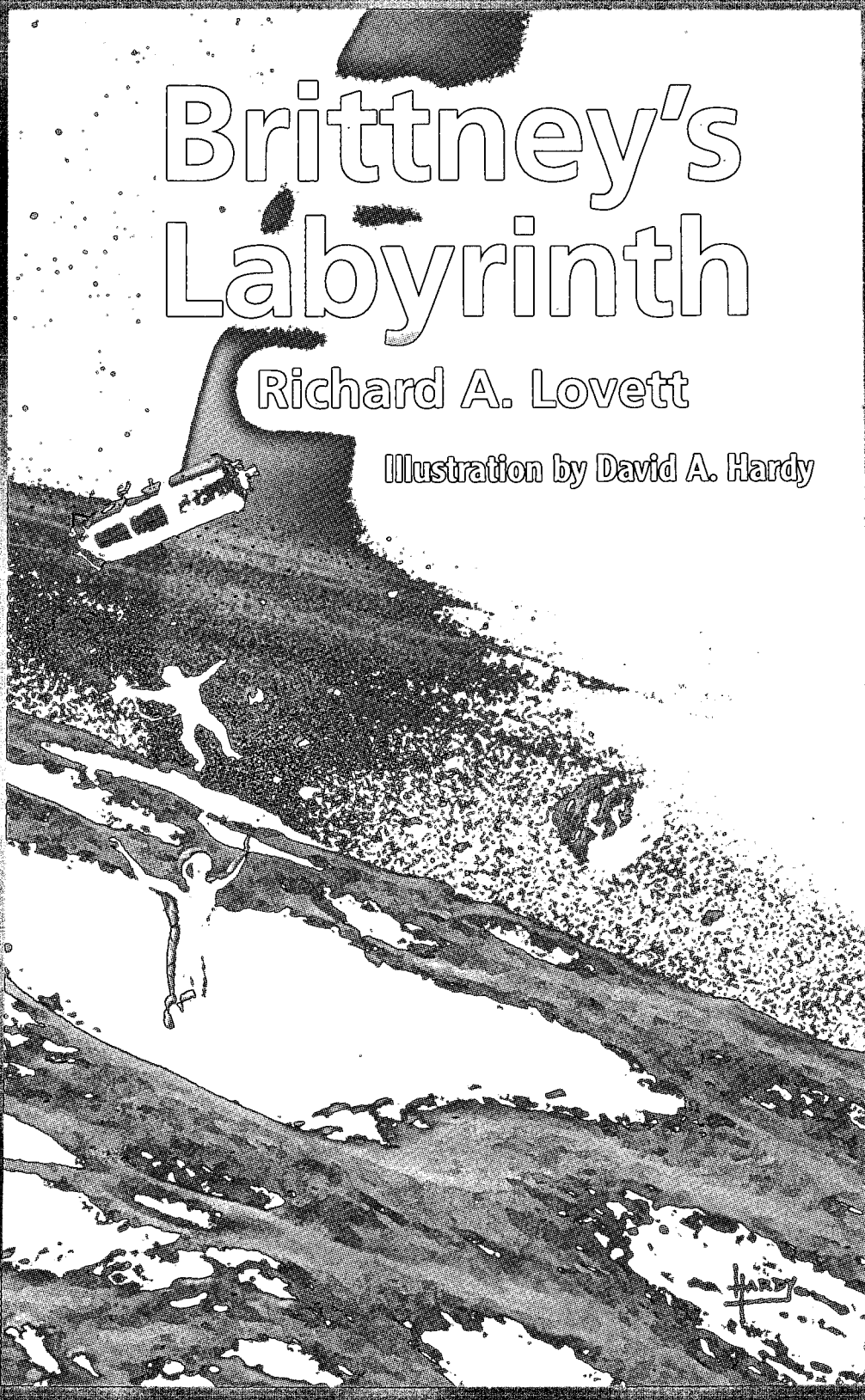
Brittney's Labyrinth

Richard A. Lovett

Illustration by David A. Hardy



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Imagine you have an entire world to yourself. Then imagine a stranger walks into your camp.

I have to hand it to Floyd; he's got a flair for the dramatic. Of course, it was my fault for telling him about Shackleton. That also made it my fault that an annum later we found ourselves cataloging Ring clumps for Torrence Rudolph III. Though I was stunned Floyd didn't rebel at the mere thought. What is it about humans that makes them take their worst fears and charge at them headlong? I *know* what I don't like, and microgravity has a lot to do with it. And Floyd . . . he has this need for open spaces. It's not that he's claustrophobic—he's a tug pilot, after all. But he hates places where things might fall on him. So why in Space did he want anything to do with a gravitational kaleidoscope like the Rings, let alone burrowing around like some kind of mole, just waiting for something to squish us?

Unfortunately, Floyd was the one with the legs, so in such matters, I tended to get outvoted.

Obviously, money was a factor, but we didn't need cash. Not that much, anyway. At least, not once we got the insurance company to actually *read* the full-replacement rider he'd had on Ship.

But I'm getting ahead of myself.

It wasn't that the parallels weren't screamingly obvious. Shackleton was an explorer who escaped death by taking an open boat across a thousand-plus klicks of the word's stormiest waters. Floyd and I built a sand sled to cross hundreds of klicks of dunes. Shackleton fetched up on the shore of a mountainous island, which he then had to cross on foot. Floyd and I did the same. So what if Shackleton was in Antarctica, hundreds of years ago, and we were on Titan? A sailboat's a sailboat, whether it floats or skids.

So, of course, I told him about it. We were on the sled for thirty-two days. I had to talk about *something*. Including the "Who the bleep are you?" response Shackleton got when he finally reached civilization. But I only mentioned it because it was a good story: not because I thought we were going to try to *copy* it. After all, we were in suit-radio range all through the final day. But once Floyd gets an idea in his skull, there's no shaking him of it. "We've come all this way," he insisted. "I want to see their faces."

As it turned out, we couldn't see much of the face of the first person we met, but his body language said plenty. He was in an old-style pressure suit, with a big fishbowl of a helmet on which he'd displayed enough telemetry from whatever he was doing that there wasn't much room for him to see out, let alone us to see in. It also turned out that while the Titan Base scientists had had a couple of skinsuits coming to them in the equipment capsule Floyd and I'd crash-landed all those days earlier, they were accustomed to people who, even in Titan's 1.6-bar atmosphere, looked . . . how should I say it?—puffy?—when they stepped outside.

Floyd had never been fat, but when I later saw him in a mirror, he looked emaciated. After a month of suit rations, you could count his ribs *through* the suit. Combine that with the compressed-air bladders behind his shoulders and in front of his thighs, and he looked more than a bit insectoid. More of a surprise than the poor guy in the pressure suit deserved, if you ask me. But then I've always been more mature than Floyd. Mature enough that I'd have radioed in and asked them to send out a crawler and give us a lift, those last few klicks. But you know how it is with men asking for help.

Anyway, once the guy quit screaming, Floyd and I were famous.

Floyd's full name, by the way, is Floyd Ashman. He likes to be called Phoenix, but you won't catch me doing it. He claims it's because it's his hometown, but that's just an excuse. Ashman? Phoenix? Way too cutesy for my taste.

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I'm Brittney. I suppose you could call me Ashman, too—most of the media did—but I don't have a last name. I'm Floyd's symbiote and I live in a bunch of computer chips implanted beneath his ribs. There's a dozen, though I could make do with fewer if I had to.

Floyd is forty-eight-year-old flesh and blood. I'm . . . well, the news pods liked to say quantum foam, but that's the chips. The real me hasn't been around much more than a couple of annums, though if I were human I'd tell you to think of me as nineteen, maybe twenty.

Floyd once asked how I figured how old I was. I told him it was based on how I feel. I also watch a lot of vids, though that's not the greatest yardstick. I've got some control over it, too, so once I got to eighteen I figured I'd better slow down or in a few annums I'd be older than Floyd and he might not like it. He's gotten better about taking help from me, but he might not do so well if I started acting too much like his . . . well, mother is a bad word with Floyd, but you get the idea.

Of course, famous or not, it took us a while to get off Titan because it wasn't as though the scientists had a spare ship lying around, all set to bump us back to orbit. Then we had to sit around Iapetus Base arguing with the insurance company about Ship.

The moment I realized they weren't going to pay up instantly, I took a crash course in insurance law. Okay, it wasn't really a course: I just hit the web and read everything I could find. For once, Floyd didn't complain about the access fees, even for data coming all the way from Earth. Though I suppose his complaints sometimes have a point. If I'm reading at full speed and have a good link (as if you can get one anywhere other than Iapetus), I can drain a pretty good library in a couple of days.

Long ago Floyd put me on an allowance. That forced me to distinguish two types of reading: data and pleasure. Data, you want now. For the other stuff, I've learned to slow down and savor. That's part of why I like vids; I can just let 'em unscroll in real time. Shakespeare's good, too. But there are a lot of things you don't *want* to savor, especially if you can think as fast as I can.

Not that it took all that much research to know that the insurance company was trying to cheap out on us. The adjustor must have had trouble keeping a straight face when she argued that the baseball-sized chunk of whatever it was that wrecked Ship was ordinary wear and tear. And even in Saturn System, where there's a gazillion things to bump into, it was rather obvious that *it* had hit *us,* rather than the reverse. I could point out about twenty places in the policy where that meant it wasn't our fault.

I'd probably have made a good lawyer, though insurance law is pretty boring. Mostly it's just flow-charting legal bafflegab designed to be so complex no human mind can possibly wrap itself around it. Any halfway decent AI could untangle it—though being sentient does make me better at spotting traps, and having a personal stake in the outcome doesn't hurt, either.

When you got down to it, the contract clearly covered a meteor strike. And it promised a replacement *now,* not five annums from now by cargo canister, low-graded all the way from Earth. That meant the company had to get off its duff, find a ship, and zip it to us with a pair of fast strap-ons. Though there was a final panic when we had to point out that nobody could possibly categorize a meteor strike as an act of war or terrorism. Not unless there are ETs out in the Oort Cloud, tossing them at us, like kids throwing pebbles into a fish pond.

Law was kind of fun. Insurance companies I can live without.

I still miss old Ship, but hey, GnuShip is one sweet bucket of bolts. Still dumb as a post, but who knows? Miracles happen. If she ever wakes up, I'd like to be there. It would have been nice to have someone around when it happened to

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me. Imagine being born fully conscious, fully educated, into a world with nothing to see, nothing to touch, and no one to talk to except one dumb AI that didn't even have a name for itself. All I had was Floyd's entertainment library to keep me occupied during the forever it took help to arrive, and that was back before I learned to savor, so "forever" isn't that far off the mark. Floyd's library wasn't all that big and if you're like me, there's no real point to rereading: you either remember it in its entirety, or file away the thing or two worth remembering and delete the rest.

I suspect I'd have made a good lit prof, too.

At the time, though, all I knew was that Floyd was alive but unconscious, having been blasted off the surface of Enceladus—maybe fast enough that we were now nothing but a new Ring particle; maybe slowly enough that we'd eventually go splat back down so hard he'd never wake up.

Somehow, the discovery of fear must have scrambled the bits just right to bring me alive. I have recollections from before, but they're like vids: someone else's memories, not mine. From the moment the geyser went off beneath us and Floyd was knocked out, my memories have a different flavor.

Loss of input may also have played a role. Most of Floyd's suit systems were knocked offline along with his senses, so all I knew was that we were maybe dying and I had no way to tell what was happening. Ship's telemetry was useless. Her instruments couldn't even see us, let alone plot a trajectory. And she was too dumb to carry on a conversation more sophisticated than: *Call for help!* (that was me); followed by, *Contacting Iapetus Base. Estimated rendezvous: eighty-four hours, twenty-three minutes.*

Sorry. Bad memory.

That's the reason I don't like microgravity. When things go wrong, there's way too much time to think about it before you find out what's going to happen. Some things *really* aren't worth savoring.

So that's how we wound up with Torrence Rudolph III. We'd have gotten some news coverage no matter what, but the scientist who'd nearly had the heart attack turned out to be a storyteller who never missed a chance to embellish. The press ate him up. Then Floyd told them about Shackleton and suddenly Saturn System was the new Antarctica. I did a few interviews, too, but mostly they treated me like your ordinary dumb AI who's simply following a canned interface when she says things like, "It was really scary," or "Piloting the sand sled was kind of fun." The rest were patronizing.

Torrence Rudolph was even worse.

Officially, he's T. R. Van Delp III, but we hooked up with him on December 24 and he had a big red nose, so I couldn't resist. The "T" really is Torrence but even with a lot of web sifting, I couldn't find a hint of what the "R" stood for. He wanted to be called "T. R.," but he was leading our way, and a guy like that just *deserves* a nickname. Maybe I shouldn't be so hard on Floyd's "Phoenix" thing.

When Rudolph first contacted us, he never once acknowledged my existence except to ask Floyd if his "imp" (a term I had to look up because I thought it was some kind of fairy) was any good at seat-of-the-pants route finding.

"Tell the *hume* I certainly am," I told Floyd, when the net served up *imp = implant (arch. sl., usu. derog.)*. And talk about dumb questions. How else did he think we'd survived on Titan?

Floyd simply asked what kind of route-finding Rudolph had in mind. He got back a long list, starting with exactly the type of stuff we'd done on Titan, where you've got no maps, no satellite beacons, and not a lot in the way of useful landmarks. I kept waiting for Floyd to ask him where he thought we'd be going where that would be necessary. Or

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did Rudolph think it was some kind of game? Maybe to a tourist type it sounds like fun to play the marooned explorer. But that's only if you've never been out there where you *can't* link, can't get a decent location fix, and everything depends on your ability to guess. That takes the fun out of it, fast.

Sorry, more bad memories.

Then Rudolph started talking about spelunking.

Okay, that's a situation where you really aren't going to be able to call out for a fix, even under the best of circumstances. But getting lost is the least of your problems, Tom Sawyer notwithstanding.

Still, I couldn't believe that Floyd didn't immediately say thanks but no thanks.

"Are you crazy?" I asked. To speak to most people, I use a com link, but I can talk to Floyd privately, via the nerve inducer that taps me into his auditory nerve. "He's talking about *caves.*"

"Yeah," Floyd said, softly enough the com wouldn't pick it up. "Maybe it's time I deal with that. Though I think he's talking hypothetically."

Then he dropped the subject. There are some parts of being human I don't think I'll ever understand. Or maybe it's just testosterone. As far as I can tell, the world would have been better off without it.

I'm not sure whether Rudolph wanted us because we were famous or because we (now) had the best tug in Saturn System.

Okay, it was also the only true tug in Saturn System. There wasn't a huge amount of work, which was why Floyd's ship was also his home. And why he had to be flexible enough in his choice of jobs to even consider hiring out as a guide.

Rudolph insisted on a formal contract which, when it came, rivaled the insurance policy on poor old Ship, with contingency clauses and secrecy pacts and a lien on GnuShip if he violated any of them. "Are you sure you want to do this?" I asked. At least there wasn't anything putting *me* up as collateral.

"It's just boilerplate. It doesn't mean much."

"Then why does he want it?"

"Because it's the way he does things. And he's offering a lot of money."

"Too much. It's like he's trying to buy us."

"So? If he's rich and wants to spread it around, why not? You've just got your feelings hurt because he ignores you."

I had to think about that. Introspection is something I'm still learning. It's hard enough to figure out why *Floyd* does things.

All I really knew was that once the contract was signed, Rudolph e-railed himself out in a private canister on a twenty-five-day hyperbola that must have cost a fortune, then slingshotted around the planet in a cowboy braking-move that showed either total insanity or high faith in his guidance system. Though it did save us a three-week chase retrieving his capsule. Maybe he's easily bored. Or maybe he's just one of those people who put a high value on their time. Either way, I tried to tell Floyd, it meant he was a risk taker.

"Nah," he said. "I bet he had a dozen people calculate that trajectory to the micron."

GnuShip had no cabin for Rudolph once we collected his canister. She's nothing but cockpit, engines, and clamps—and the cockpit's barely big enough for the pilot's couch and an exercise station. So until we got to Iapetus and hired a skimmer to take us down, the only difference between talking to him on Earth and talking to him here was no speed-of-light delay. Not that Rudolph was much of a talker. In that, he's a bit like Floyd.

His canister was impressive: a whole bunch bigger than GnuShip's cockpit, and a lot better furnished. Whenever he

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talked to Floyd by comcam, I peered over his shoulder, studying details.

Floyd was doing the same. "It's like a first-class liner," he said, "only better."

"Way better." Not that there's such a thing as a first-class liner this far out. "It's also stuffed with equipment. Did you see that box behind him? It's a Spektrum 12000."

Floyd's voice carried a tone I've learned to be wary of. "Which is what?"

One of the things about growing older is that I've learned that Floyd doesn't like the Socratic method. He calls it "guessing games" and accuses me of being condescending. It's weird, because when I was reading up on insurance law, I discovered that law professors always teach that way, and nobody accuses them of anything. But Floyd's a bit old for a student, so maybe that's the issue. Anyway, he doesn't like it. And, to be fair, I myself would have had no idea what it was if we'd been more than a few light-seconds from the Iapetus Base web.

"It's what they call a lab-in-a-can," I said. "High throughput but low multiplicity."

"Huh?"

"That means it can run a lot of samples, but it can only perform a few tests on each of them. He's got a whole bunch of other stuff in there, too. I'm still trying to figure out what some of it is, but I know I saw a quark detector and a stellar occlusion analyzer. He's also got five skinsuits, plus a whole array of gloves and boots, and—"

"So does any of this actually matter? Apparently he likes toys."

Someday I'm going to learn to be concise. The problem is that life is so full of interesting things. "Not really."

I might have been able to learn more if I'd had the nerve to probe Rudolph's canister systems. Floyd would have objected, but I hate mysteries. Enough that I'll give myself an extra year's age when I decide to control the impulse. The one time I attempted to slip into Rudolph's canister, though, merely to hijack his comcam for a better view, I bumped into a rather impressive guardian program that nearly caught me.

That left me with little more than what I knew of Rudolph from the web, which was both plenty and not all that much. According to the web, he'd made his bucks in the futures market: asteroidal iridium, mid-ocean-ridge copper, even some speculative stuff regarding hydrothermal vent mining on Europa if the environmental restrictions are ever lifted. As far as I could tell, he'd never actually mined anything—just bought and sold the rights—but he'd done pretty well at it and could definitely afford to hire us for as long as he wanted.

None of which really explained the equipment in the canister.

But Floyd wasn't concerned. "Would you relax? He's just a rich speculator, playing tourist. What's so weird about that? And his name, damn it, is T. R."

Iapetus Base is on the surface, and neither *T. R.*'s canister nor GnuShip was designed for a hard landing. That meant we finally got to meet in person, boarding the skimmer.

On the vidscreen, Rudolph had a face to match his nose: broad and florid, with a shaggy mane of hair overhanging strong eyebrows, and cheeks showing the mottled beginnings of lesions that would probably someday need the ministrations of an oncologist. Spaceburn? Or too many days on ozone-damaged sections of Earth? My web reading gave no clue, but his complexion bespoke a man who'd spent a lot of time without caring enough about UV filters. I raised my estimation of him by a point or two. Wherever he'd been trolling for melanomas, it had been under harsh conditions that most wealthy people would have avoided.

Not that he treated me any better in person than on the com. He concentrated on Floyd, shaking hands firmly enough I could sense Floyd wince, even

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though I'm not wired into his tactile impressions. His grin was broad and his voice as hearty as his handshake, and he had a tendency to drape an arm over Floyd's shoulder and lean close to speak—as though he didn't already have enough decibels. According to the psychological literature, that hale-fellow-well-met stuff simply reflects a "man's man," slightly out of his comfort zone. But I kept wondering if Rudolph knew exactly what he was doing.

Not that Floyd wanted to hear it.

"Yeah, he's a bit forced," he said, "but give it a break, Brittney. He's just trying too hard, that's all."

We'd barely touched down at Iapetus Base when Rudolph announced that he wanted to go backpacking.

Someday, Iapetus will be a tourist destination. The view of the Rings is breathtaking, the terrain dramatic, the stars space-bright. If it were flat, it would also be easy walking because, even though it's fairly large—about thirty percent the diameter of Titan—it's a lot less dense, so you don't get all that much gravity. A whopping .023 gee. Not a lot, but five times more than Enceladus, and there aren't any geysers to blast you off into space.

What there are, are things to fall off of. Mountains, to be precise: huge ones. Think Olympus Mons, but steeper and up to fifteen klicks high. In terms of the ability to kill you, Earth's higher gravity gives it worse cliffs. But as some mountaineer said on one of those vids from which I only chose to remember snippets, "Dead is dead." Beyond a certain point the size of the drop hardly matters.

You'd think Iapetus would be pretty well explored. And while there have been some geological surveys—science is one of the few things Saturn System can export—the base is mostly just that: ice mines, habs, and a convenient place to park yourself between jobs. Easy to get to, easy to leave, but on a moon big enough to feel like a real world. As far as I could tell, nobody before us had ever "gone" backpacking.

"That's why I hired you, Floyd, old boy," Rudolph said. "You know how to get around places like this. So let's get at it. I've got everything we need in my canister."

Which of course meant we had to pop back up to orbit to get it, which was an irritating waste of propellant. That's the trouble with rich guys. They think that because fuel comes out of the ground, it's free. Though at least Floyd got to spend a night in a guest hab and take a real gravity-fed shower, which he views as a luxury, even if the gravity's so low that *fog* is a better description of the experience.

Rudolph probably just took it for granted that a skimmer's worth of orbit-to-ground propellant was a reasonable price for a shower. Maybe Floyd was right and he was just a rich tourist.

Rudolph did have everything we needed. In addition to one of the skinsuits I'd already seen, he produced a pressurized bubble tent, climbing equipment that looked capable of dangling us from precipices where sane people would rather not dangle, and a portable version of the Spektrum lab-in-a-can, plus self-heating food packs, an ice/water purifier, and a bunch of other stuff that probably included lounging-in-the-tent clothing and an inflatable pillow so he could sleep soundly. When he piled it all in the skimmer, it formed an impressive mountain. On the surface, it would only weigh twenty or thirty kilos, but it would have full Earth mass, which would make it hard to carry, especially near any of those monster cliffs. I could see the epitaph now: "This crater dedicated to the memory of Floyd and Brittney, who, at the abyss of the Great Precipice of You-Wouldn't-Believe-It, discovered that a backpack in motion tends to remain in motion a lot longer than you'd expect." Or something like that. I

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could do better if I put my heart in it.

Other than the size of the pile of equipment, what was hard not to notice was that Rudolph only had a one-person tent. Floyd, apparently, would get to sleep in his skinsuit. I guess Rudolph figured we had plenty of experience at *that*, too. Poor Floyd. I've only got direct access to two of his senses, and from my point of view there's not a lot of difference between being in a suit or a ship. Floyd says I'm lucky. On Titan, he tried to explain what it felt like by the second week, but the best I could come up with was that it was like being forced to watch an excruciatingly bad vid, over and over. Or maybe having to spend all your time with Rudolph.

At least Rudolph was prepared to share his food—though he really didn't have much choice. We had lots of ship rations, but his supplies were a good deal more portable and more easily prepped in the field.

Floyd didn't have a backpack to carry any of this stuff, but that, it turned out, didn't matter, either: Rudolph had one that fit him perfectly. Of course, he only had one large pack. The other was a lot smaller. Big surprise. Floyd was definitely going to have to watch his momentum at the edges of those big cliffs.

I will give Rudolph points for one thing. Iapetus really is spectacular, and he picked the best destination, the equatorial ridge.

Iapetus is a weird moon, looking as though something a long time ago squeezed it hard. The pressure squirted up an enormous ridge right around its equator, so tall that on Earth an equivalent mountain range would jut all the way through the stratosphere with a lot to spare. That's where the biggest of the big mountains tend to be.

Rudolph wanted to pick the highest part and hike the crest.

"What?" I said, "Is he nuts?"

"Shush," Floyd said.

But I was already looking at the map. The ridge wouldn't be flat on top; nothing that tall is flat on top. And there were bound to be places where the footing would be like sloping ball bearings. It's an airless world, so the regolith was going to be all crunched up by micrometeorites, producing a lot of loose stuff that would accumulate on the steeper slopes. Not to mention that most of the ridge passes through Iapetus's dark side, which would add to the scree.

The dark side isn't called that because it's always night (it isn't). Rather, it's because it's on the leading side of the planet as it moves around Saturn, allowing it to have swept up all kinds of dark junk from somewhere or other.

Because several of the other moons are also dark on their leading faces, the prevailing theory is that a long time ago, something that's no longer with us got really clobbered by something else, and fragments wound up all over Saturn System. Maybe the dark stuff is the core of the deceased moon, or maybe it's fragments from whatever it was that hit it. Or both. For what it's worth, I can write sims that make any of those work.

There's another theory that says the whole ridge is debris from a prehistoric ring that collapsed onto the surface, then congealed like some kind of volcanic ashfall from space. I can write a sim that makes that one work, too, though it doesn't explain why the ridge is perfectly normal Iapetus ice, with the dark stuff ladled over it like charcoal-colored dust.

Then there's the theory that says aliens built it. If so, they've been slow to explain why, but maybe they're extinct. Or maybe they really are out there in the Oort Cloud tossing rocks at us, hoping we'll go away.

And maybe I've been watching too many vids.

What I do know is that I've read enough mountaineering stories to know that rock climbers have a term for such stuff: rotten rock. And even if we didn't fall off a cliff, fifteen klicks is a long way to tumble.

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"Don't do it," I said. "He's crazy."

"Quiet!" Floyd hissed. Then, "Sorry, not you."

Rudolph raised an eyebrow, but didn't say anything.

"Damn it," I said, surprising myself. I don't usually use language like that. But then I don't usually get angry, either. "I'm part of this, too. Why the hell can't he acknowledge it?"

At least Floyd didn't ignore me, too. "Excuse me a moment," he said to Rudolph, then turned away from him. "Can we talk about this later? Maybe it's just habit with him. Or perhaps he doesn't know what to make of you. Most people have never met a sentient AI, so maybe he just thinks of you as a really good interface. Hell, maybe he doesn't like women. Who knows? It's his problem, not yours, but he's the client, so let's see if we can get him what he wants without killing ourselves, okay? Trust me. I've seen the pictures of that ridge crest, too."

We settled for a base-camp trip. That reduced the load, allowed Floyd to return occasionally to sleep in the skimmer, and meant there'd be no long-distance ridge walking.

Unfortunately, it also meant that when we were at the skimmer we'd have to share it with Rudolph, since it was a lot bigger than his tent. Me, I'd have rather stayed outside in the suit. But as Floyd pointed out, I didn't have a nose and had never itched from anything other than curiosity.

From our base at the skimmer, we would try to climb the ridge, which nobody had ever done before. I thought Rudolph would like that, since a first ascent would get him all kinds of press on the climbing nets. But he was pretty grudging about giving up his trek. "Okay," he said at last, "But I don't want to just bag peaks. I want to cover as much ground as possible."

Floyd didn't comment, and for once I managed not to ask what the hell, then, we were doing.

* * *

The first attempt, we got nowhere near the top. But Rudolph didn't seem to care.

We'd decided to start in the Trench, the deep valley that separates the Ridge's two parallel crests. From there, it wasn't quite as big a climb as from the plains on either side. Floyd had expected an argument, but Rudolph simply grunted, pointed at the map, and said to pick a place somewhere in "that" vicinity. Then he left it to us to choose a summit.

Iapetus is well mapped, but not for hiking and certainly not for mountaineering. Still, flying over, it was an easy thing to take stereoscopic images and convert them to contour maps. Easy enough for me, anyway. That let us pick a nice collection of peaks with climbing routes, which, on a twenty-meter topo at least, didn't look too deadly.

We set down near the easiest-looking summit, a mere ten thousand meters above us: three times the height of Mt. Everest above its base, though at least it looked as though we could scramble up without having to dangle from any cliffs. I'm sure Rudolph's climbing equipment was top of the line, but I was happy not to have to put it to the test.

We set out with the bubble tent and seventy-two hours' supplies. At first, we made good progress, but after the first few klicks, Rudolph kept stopping to poke at rocks, especially in the densest drifts of the loose, dark stuff that gave the dark side its name.

Whatever it was, he loved it. But he wasn't acting like any geologist I'd ever heard of. Rather than putting samples into carefully labeled bags, he'd grab a handful here, a handful there, and another elsewhere, and shove them all into the same sack.

We did that all through the first twenty-four hours, pausing only for a sleep break. At least Rudolph slept, in his bubble tent. The next day, Floyd was getting frustrated. "Are we climbing or

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prospecting?" he asked, quietly enough that the question had to be directed to me.

"Darned if I know." By this time Rudolph had acquired, by my estimate, thirty kilos' mass in rock—enough that it was starting to affect his balance like the backpack was affecting Floyd's. "But if he finds anything valuable, he'll never know where it came from."

"Yeah," Floyd said. "I noticed." Then he spoke up. "That bag's getting pretty full, T. R. Do you want a hand?"

Rudolph barely looked up from his current patch of scree. "If I want help, I'll ask for it."

Floyd raised his hands, defensively. "Whoa. Just offering."

But Rudolph was looking at the ridge, still thousands of meters above. "We aren't going to make the top, are we?"

"Not if you want to breathe on the way down," I said, but not on the radio. If Rudolph wasn't talking to me, I wasn't talking to him, either.

Floyd was more diplomatic. "Probably not. We have to turn back in . . ."

"Seven or eight hours," I supplied. "Give or take."

"Four hours," Floyd said. "But at least we now know a route that looks like it might work."

"Fine." Rudolph barely glanced at the summit we'd not obtained. Nor did he spare much attention for the view opening out over the valley below. "I don't suppose we could go back by a different route?"

"Not the best idea," Floyd and I chorused, though of course, Floyd was the only one he could hear.

"Thought so." Rudolph was already turning around. "Oh well."

Iapetus is tide locked to Saturn, and its day is seventy-nine Earth days long, so nothing much had changed by the time we got back to the skimmer.

"Let's go for a walk," I said to Floyd.

"Isn't that what we were just doing?" His voice was quiet, but in the stillness of the skimmer there was no way Rudolph couldn't tell he was talking to me. Long ago, spacers had learned the value of silence. If humans are trapped with it 365 per annum, anything that squeaks or hums can drive them nuts. Silence, on the other hand, can always be covered with a personal sound system.

Unfortunately, Rudolph had no problem with silence. That meant that while I could talk to Floyd privately, it was hard for him to respond once he'd taken off his suit.

"Tell Rudolph you want to take sunset pictures," I added.

"Sunset's got to be at least ten or eleven days away."

Sometimes, I swear, Floyd is deliberately obtuse. But this time he was just tired.

"Can't you tell me about it in here?"

"No."

He sighed. "Okay." Then, to Rudolph. "I'll be back in a bit."

"'S long as we start on time tomorrow."

Rudolph's eyes were shut, but I couldn't tell if he was thinking or nearly asleep.

Floyd didn't say anything more until he'd put on his suit and the airlock was cycling. "We could have just used the suit headset."

"Yes, but I want to talk about him without having to see him."

Of course, I was monitoring the skimmer's telemetry, so I could still see him, but this felt different. Rudolph was now awake, feeding bits of black scree into the mini-Spektrum. I wondered if he knew I was watching. Or if he cared. If I was merely a thing to him, it might not matter.

"What's he want with all that stuff?" I asked.

"What, the rock and dust he's collecting?"

"Yes." Though I could also have asked about the mini-Spektrum and everything else.

"Maybe he's looking for something."

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"For what? Besides even I'd have no clue where it came from."

"Good point." The airlock had finished its cycle and we stepped out. "Do you remember when Mt. Rainier erupted and blew half of Seattle to hell?"

Remember wasn't quite the word, but I'd read of it. "Yes. Though it wasn't anywhere near half. More like a couple of suburbs."

"Yeah, but afterward people collected the ash and made all kinds of things out of it—sasquatches and grizzly bears and totem poles and Space-2-Needles and things like that."

"So you think Rudolph is planning to set up a curio stand? What's he going to call it? 'The remains of Planet X?'" What classical beast vanished into thin air? Oh yes. "Or 'Tails of the Cheshire Cat?' Assuming this stuff has anything to do with a destroyed moon. Maybe it's just Ring dust."

As long as we were outside, Floyd really did start taking a stroll. "I didn't say it was something I'd do. Just that people tend to collect stuff like this, so you can't read too much into it."

Some of the few pieces of equipment of his own that Floyd had picked up on Iapetus Base were trekking poles. He'd suggested that Rudolph buy a pair, but Rudolph had merely scoffed. That's because Inner System ground rats tend to hop when they try to walk in low gravity, wasting energy by bouncing up and down rather than going forward. A flatter trajectory is more efficient, especially if you can stabilize it with poles.

It works best on flat surfaces, like the Trench. Occasionally, Floyd had to dodge large rocks, but in low gravity, poles are better for that than legs, and while he hadn't had poles on Titan, he knew how to use them. He struck a rhythm, and soon the skimmer disappeared beneath the curve of the horizon.

We went on like that for about fifteen minutes. There wasn't much to say, and neither of us said it. Floyd is an athlete at heart, and I knew he'd be lost in the rhythm of motion and breathing. Me, there's no way I can understand that stuff, except intellectually. I was lost in the view.

Before us, Saturn stood above the Trench in bands of pastel, the Rings almost but not quite edge-on, cleaving the heavens like knife. The sun hung slightly off to one side behind us, low enough that shadows limbed the ridges' steeper slopes, making cliffs look even worse than they were and creating the illusion of cliffs where there weren't any.

Titan had had dramatic landforms, too, but they'd been blurred to a smoggy murk that distorted contours, hid the sky, and created a uniform orange pall. Here, everything stood out in crystalline detail.

Eventually, Floyd stopped and surveyed the vista in silence. Then he sighed. "That felt good," he said. "It's different when it's just us. And it's nice to actually *move*, rather than making like a pack mule. But we better be getting back."

"I've got something I'd like you to listen to first," I said.

"Sure. Though I really don't think T. R.'s as bad as you believe."

"It's not him." At least, not directly. Without Rudolph to distract Floyd and leave me with a lot of time to fill, I might never have found myself at this point.

Suddenly, I was afraid. Not with the fear that comes from thinking of dangling from giant precipices, but with a fear that, if anything, struck deeper.

"I call it 'Iapetus Air,'" I said.

"There's not a lot of that around here."

"Ha, ha. No, an air is kind of like a song without words, usually done on a violin."

"You want to play me a piece of music?"

I wasn't sure what I detected in his voice. Floyd doesn't listen to a lot of music. Maybe this was a mistake.

"Yes." I was more nervous than ever.

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"It's short. And Celtic." Not that Floyd would particularly care about that. But even though the Celts came from a green country, it was stark and rocky around the edges, and I thought they might find something familiar in this landscape.

I suppose I could still have backed out. Instead, I put everything I could into it: the bleak landscape; the untouched and so-far-untouchable peaks; the loneliness of being ignored, of watching but not participating, seeking but not finding. When it was done, Floyd was silent for long enough I was sure my worst fears had materialized, though when I checked it was only a few seconds.

"Is that a recording?" he asked.

"What do you mean?"

He paused again. "I guess I'm asking where it came from."

"I wrote it."

More pause. "Now?"

I'd been thinking about it all day, but the final composition had been done in real time. Improvisation, they call it, though of course I've got a considerable ability to time-shift my perceptions and cheat.

"Yes," I said, because it was the simplest answer.

"Wow." He paused again. "Like, really wow." Still another pause. "What brought that on?"

I had to think about that a bit because there were plenty of other things I could have done in my free time, including sampling the vids I'd collected back at the base.

"I really want to make it to the top of one of those things," I said.

Which wasn't really an answer. What I wanted was . . . something. That's what the music had been about. The summit was just a symbol. I only wished I knew of what.

The next two attempts were like the first. A day of intermittent slogging while Rudolph collected endless samples. A camp where he slept in comfort and Floyd didn't. Then a few more hours of not getting anywhere close to the top, a descent, and another camp in which I tried to figure out what it was that the summit meant. Whatever it was, Rudolph didn't share it. Both times, he targeted a new peak, squandering whatever route finding we'd done and never particularly exerting himself to reach the top.

The fourth attempt was different. Rudolph left his sample bag and looked up, rather than at the ground. "Is it really true that nobody's ever climbed one of these?"

Floyd didn't even bother to ask me to check. "Yes."

"Then I suppose we should remedy that. After all, that's what we're here to do, isn't it?"

Now that we were finally committed, it would have been easy if the sun hadn't been getting low, creating huge shadows. Saturn light and reflected glare from surrounding slopes softened them a bit, but human eyes weren't made for this. It wouldn't have been a problem if Rudolph had included a couple of good pairs of contrast-reduction goggles somewhere in that enormous pile of equipment, but the ones he'd brought were designed for Mars, where there's an atmosphere to soften the light.

That left me. I could see perfectly well by doing my own contrast-adjustment on the view from the cam Floyd had mounted for me on his suit. But when I tried feeding that back to his headset, the parallax messed up his depth perception enough that he kept tripping over things. Eventually, I showed him the enhanced display when he asked for it, but mostly I just gave directions: *It's not as steep on the left of the big cleaver,* or, *go right unless you want to get boxed.* That kind of thing.

I thought about sending the enhanced image to Rudolph, but he was the one who'd squandered all the good light be-

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fore we needed the goggles he didn't have, so I figured he'd just have to trust us. Or Floyd. Somehow I felt no desire to show off to Rudolph. Was that a form of maturity? Or would Floyd say I was sulking?

As we neared the top, the slope abated along with the shadows. And then we were up.

"What's the name of this peak?" Rudolph asked, taking the lead just in time to be first to reach the highest outcrop.

"It doesn't have one," I said.

"Whatever you want to call it," Floyd said. "We can register it with the . . ."

"—Interplanetary Commission on Nomenclature," I supplied.

"—proper authorities, when we get back to the skimmer. Mons Van Delp?"

We camped on top, which isn't as big a deal as it sounds, since this wasn't Earth, where mountaintops are exposed to all sorts of nasty weather. Here, it was simply a convenient flat spot. For once, Floyd didn't seem to mind being outside. He parked himself on a convenient boulder, looking toward Saturn. To one side the view fell into the Trench. To the other, the drop was even bigger, onto a plain bounded by a crater-etched horizon that was either too close or too far, depending on your point of view. Rudolph would find it cramped. Floyd would find it big, almost like being in orbit without a ship.

Saturnward, down the ridge, the black deposits thinned, revealing ever-larger patches of underlying ice.

"That one's Mount Zebra," I said.

Floyd laughed. "Which of the nearby peaks is the highest?"

I consulted the topo I'd made days earlier. "See that long crest over there? At about two o'clock, across the Trench?"

"Uh-huh."

"Its highest point is about two hundred thirty meters above us."

Floyd laughed again. "Brittney's Bump," he said.

The descent was easy: just a matter of retracing our steps—literally when the regolith was soft enough to have preserved them, figuratively when we had to rely on my memory.

Then we were back in Iapetus Base for another night in a guest hab, followed by a quick boost back to orbit, with Rudolph again secluded in his canister. I presumed he was feeding all those kilos of dust into the full-sized Spektrum, but he must also have been writing net reports. Hours later, Mons Van Delp and Mount Zebra had made the map; Brittney's Bump hadn't, partly because Floyd never suggested it to him.

I wasn't quite sure how I felt about that. Having a mountain named for me would have been fun, but it would be nice for the name to be a little more dignified. Out of curiosity, I downloaded a bunch of Inner System topos and found all kinds of intriguing names, ranging from obvious glory-hounding to oddities that must have had good stories behind them, like a river bend called Crook's Elbow and a coal-mining town called Goldbug. Then there were the ones you didn't want to think too much about, like Dead Prussian Point. Maybe part of the fun of visiting such places is trying to figure out how they got their names. At least Mount Zebra is obvious. A hundred annums from now, nobody will care about Rudolph's mons.

And then, we were off to the Rings. No explanation, not even a thank-you, unless one of those arm-on-the-shoulder things counted, back in the skimmer. As far as I was concerned, it was too much like patting a dog on the head for a good game of fetch. Kind of like Floyd at his worst, only more so.

When Rudolph had first talked about caves, I thought he might be wanting us to go back to Titan, where there are indications that methane ground—uh, "water" isn't quite the right word;

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aquifers? methanofters?—might have carved out passages similar to earthly caverns.

But that wasn't it. He was looking for moons in which he might be able to crawl in one side and come out the other: right through the center like some kind of skin-suited Jules Verne.

Not that he told us this until we were well away from Iapetus. Then he clamped down an embargo on outside communications, complete with a monitoring gizmo that would notify him if we so much as pinged an orbital beacon.

"You have to time the publicity on these things," he said. "Climbing was just the warm-up. If we play it right, we're going to make that Shackleton guy look like a total amateur."

We started by cruising above the Rings, looking for clumps. There are millions of them, maybe tens of millions, but they're not very stable, so nobody's ever tried to catalog them. However many there are today, there will be a different number tomorrow.

Luckily, we weren't trying for a full list, either. Mostly, we were looking for the biggest clumps we could find and checking their densities.

It didn't take a genius to figure out that Rudolph was hoping they'd be tunneled through by caves. But caverns have to be formed by something. I'd read up on them way back, when Rudolph first asked about spelunking. On Earth there are three types: water-carved (not likely here), lava tubes (ditto), and talus caves. Clearly, Rudolph was interested in the latter. On Earth, they occur beneath piles of big boulders. Obviously, he hoped that some of the clumps would be similar, but to figure out which ones had a chance, he needed to measure their densities. Too low and they'd just be temporary amalgams of bumping, grinding boulders, too dangerous even for Rudolph. Too high and they'd be too solid for tunnels. Obviously, Rudolph was hoping for something in the middle.

The classic method of finding the density of a moonlet is to do a flyby and watch your course change. But the clumps are *in* the Rings, where a flyby at anything but the slowest creep isn't something anyone in their right mind wants to do. There's just too much stuff to bash into, and no insurance in the Solar System would cover us if we did.

At first, that produced a bit of a stalemate.

"I'm paying you to do what I say," Rudolph said, all trace of arm-on-the-shoulder bonhomie gone.

"Not that, you're not."

"I suggest you read your contract. Especially the part with the penalty clauses."

"I told you not to sign that thing," I said.

"Damn it, Brittney, that's not helpful."

He was, I had to admit, right about that. "Okay, so we have to do something creative." I thought a moment, then had it. "Look, we've got a tug. Why don't we just throw things?"

And so, Operation Slow-Pitch was born. Floyd got credit for it but that was okay. I no longer cared what Rudolph thought of me.

The idea was dead simple: all we had to do was dip into the edges of the Rings, grab a nice chunk of ice, push it in the right direction, and watch how the clump's gravity altered *its* course.

We found a wide range of densities, some of which looked promising. But when we eased in close to a few of the better candidates and pinged them with the ice-penetrating radar, they proved to be nothing more than giant dust bunnies. Fluffy snowballs, with a few denser chunks for those who might prefer to think in terms of raisin bread. The point is, you'd have to dig a tunnel before exploring it, which kind of defeats the purpose. Not to mention that we had nothing with which to dig.

I suppose we could have ordered up

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some mining equipment, but that would have left half of Iapetus Base wondering what we were up to. Rudolph obviously preferred a fait-accompli approach. His corporate MO had been to hover around the edges, then sweep in and *poof,* he'd have seventy percent of the iridium in the system. Or all the mining rights on Europa. Not that I could imagine anyone wanting to beat him to the punch on the Jules Verne thing, but maybe when it comes to secrecy he's like Floyd was about Shackleton. Once his mind gets in a track, it stays there.

Eventually, when I think even Floyd was about to die of boredom, Rudolph called a halt.

"We could do this forever," he said. "Right now I'm opting for this one"—he pulled up an image of a two-klick object whose main distinction was an unusually dense sprinkling of raisins—"but I'm not terribly hopeful. Are we missing something?"

There are lots of answers to a question like that, especially when you're caught in a stupid contract you'd like to get out of. But Floyd must actually have wanted to go spelunking. "What about the gap moons?" he said. "They're less likely to have picked up all that fluff that's blocking the tunnels."

We started with Atlas.

There are a lot of gap moons, depending on how you define *moon* and *gap,* but the best known are Atlas, Pan, and Daphnis. As the term indicates, they sit in the gaps, which they maintain by gravitationally ejecting stray Ring particles. They all have specific gravities well below 1.0, which means they'd float if you dropped them in the ocean. Well, Atlas is big enough it would hit bottom like a stranded iceberg, but you get the idea. If Rudolph was lucky it would be honeycombed with caves. I hoped otherwise.

The gap moons haven't exactly been hot spots of exploration. As far as I knew, we were the first to land on any of them. They're in that awkward size range spacers avoid: too small for a real moon, bigger than you need if you're too cheap to buy propellant and want to melt your own.

Fortunately, it really doesn't take all that much gravity to crush caverns to impossibly small passages. Rudolph dug out all kinds of equipment—not just the ground-penetrating radar, but the quark detector and enough neutrino sources that it took three days to deploy them all. When he was done, we'd basically CAT-scanned the whole place with neutrinos and quarks and found that it was more like pumice than honeycomb: a frothy mess whose bubbles were probably too small to crawl through, even if you were a bee. Chalk one up for my kind of luck.

Pan was more of the same. But Daphnis was different.

To begin with, it's got the lowest density of the lot—so low it wouldn't just float, it would rise out above the waves like a gigantic chunk of FrothFoam.

Even from space we could see a couple of big, promising-looking holes. Well, promising to Rudolph. *Maw of hell* was more appropriate. I couldn't imagine how they looked to Floyd. His parents had been crushed in an earthquake when he was barely old enough to remember, and now, unless he wanted to lose GnuShip and pretty much everything else, he was going to have to descend into the bowels of this thing that was probably about as stable as a pile of marbles. Big marbles, in the type of microgravity that makes Enceladus look Jovian by comparison: where, if anything shifts, we'd have more than enough time to watch it slowly close down our exit—or, as the case might be, us.

That was bad enough. But the neutrino-and-quark scan revealed that not only was it a true talus maze of passages, there was a chunk of something dense at its center, shaped like a fat pumpkin seed: half a klick long, three hundred

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meters wide, and maybe two hundred meters through at its thickest—the biggest raisin yet. Whatever it was, it looked as though the entire moonlet had somehow accreted around it. An asteroid? For all I could tell it was a spaceship abandoned eons ago by those ETs out in the Oort Cloud.

It made me nervous. With a moonlet made mostly of ice, all you need is a heat source to have Enceladus revisited. Maybe the caverns were a natural spiderweb of piping just waiting to blast vapor out of the interior. This place had an escape velocity of only a couple of meters per second, so it wouldn't take much of a geyser to spew us on a one-way trip to nowhere.

Still, it was hard to imagine an asteroid radioactive enough to generate that kind of heat. And while an ancient space drive might do the trick, I didn't believe in the aliens. Not really. Maybe.

I didn't know what Rudolph thought, but he was obviously determined to go in. Floyd too. Me, I had no choice.

What I resented was that nobody asked me. Floyd hadn't even given a decent reason *why* he was so determined to face this thing. If we died in there, I hoped like hell he at least had time to explain.

Superficially, Daphnis looked like any other Outer System moonlet: oblong and knobby, with an icy crust pocked by impacts.

Rudolph's neutrino-and-quark scan, however, had shown the crust to be thin: in places, only a hundred meters or so thick—a late-forming layer that had clogged the talus-cave pores, hiding the warren of passages lying below and probably, like a thick eggshell, helping to hold this loosely consolidated world together. Though, as we could tell the moment we got close enough for a good look, not all of the pores were blocked.

The openings took the form of funnel-shaped craters deep enough you could only see their bottoms when they faced directly toward the sun. Most didn't punch all the way through, but a few ended in holes—some small, some big enough to swallow a modest-sized cargo canister.

What the funnels were, were sun cups, where impacts had dimpled the crust deeply enough to produce a runaway reflecting-oven effect that melted them ever deeper. They're rare in space, but on Earth, little ones can cover entire snowfields with honeycomb arrays of knee-deep holes: cool to look at in vids, but a bane to hikers. These were enormous and evil looking. Not honeycombs, but trap-door spider holes whose shadowed depths harbored entrances to the underworld. Even without spiders, not appealing-looking places to visit. No easy honey here: only death, minotaurs, and serpents.

Landing was a nuisance. In theory, even though GnuShip's not made for gravity, we could have just set her down. In gravity this light, nothing was going to break. But neither she nor Rudolph's canister had a well-defined "up," which even in microgravity presented problems. And the only things that might function as landing struts were docking clamps, which weren't really designed for support. While Saturn System's shifting gravities don't make for *that* many moonquakes, it was going to be bad enough worrying about them down inside the caves, without wondering if GnuShip might topple and strand us. All told, it was simpler to park her in low orbit and come down by hand thruster, picking a spot near one of the poles, because that's where you get the highest gravity.

Even without giant sun cups, hiking around a super-low-gee world is an exercise in frustration even for experienced spacers. So we began by caching an extra pair of thrusters at the mouth of the sun cup from which we planned to exit. Then I gave Floyd the thrust coordinates for a suborbital hop to the cave we were

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using as an entrance.

We made it with only a couple of mid-hop corrections. In a thruster competition, my presence would give Floyd an unfair advantage—though not that much of one, because any dumb AI can calculate a trajectory. The real skill, which Floyd is good at by human standards, lies in timing the burst and aiming it in exactly the right direction.

It's one of those things, like walking on Iapetus with trekking poles, that most humans find easy to learn but hard to master. I've always wondered what that's like. If I can do something at all, I can master it. If I can't do it, it's because I'm not hooked up to the right servos.

I think it's the entire concept of "skill" that eludes me. I understand the idea, but only in an intellectual way. The best I can figure, it's like working with a servo whose controls get more precise the more you use them. But then it wouldn't be *you* that's getting better; it would be the servo. Somehow, human self-identity includes a connection between their bodies and themselves that I'm not sure I'll ever really figure out. It would be like me caring what kind of chip I lived in. I do care about processing speed and memory, but I don't think that's quite the same thing.

Anyway, an hour later, we settled back to the surface, light as a feather, on a flat spot within fifty meters of the sun cup.

Rudolph didn't do as well. It took him several extra course corrections to match Floyd's trajectory, then he accelerated in for the landing, arguing that he wasn't going any faster than if he'd jumped off a one-meter embankment on Earth. Which was true, except he still came in plenty fast to sprain an ankle, if he hit wrong.

"Cowboy," I muttered.

Floyd flipped off his suit radio. "More like making a statement. He's telling me he's not afraid of this stuff—which probably means he is."

"Like you and this whole trip?"

"I'm not showing off."

"No. The only person you're trying to prove something to is yourself. Do you realize how many things could go wrong down there?"

For once, he didn't tell me to drop it. He merely tuned me out by flipping his suit radio back on. "You okay?" he asked Rudolph.

At least Rudolph wasn't carrying the pack. In microgravity, as on Iapetus, the disconnect between weight and inertia is tricky, even to the best. So is landing without bouncing, and Rudolph was now in an undignified tumble, struggling to check it with his thrusters, twenty meters above the surface.

"Serves him right," I muttered.

Floyd just stood clear and waited for him to settle. Even with a bit more caution, it still took Rudolph three more bounces to stick the landing.

When he finally came to rest, he was furious. "I bet you and your damn imp really enjoyed that," he said. "Why didn't you give me a hand?"

When Floyd's in his suit, I've got all kinds of medical telemetry on him, and I could watch his blood pressure rise. If I had blood, it might be doing the same. I nearly popped into the radio link to tell Rudolph that if he had something to say, he could say it to me directly, but I (barely) managed to control myself.

Floyd did the same. "Not possible," was all he said. "Too much momentum, not enough gravity."

Then he switched his mike back off. "I hate places like this. Give me good old-fashioned real gravity, even if it's just a hundredth of a gee. Something that actually keeps you and your equipment stuck to the surface, like God made you to be."

I would later wonder if Rudolph had been deliberately trying to provoke a fight: an excuse for that which would follow. It was the same with the route plan. We should have gone in the hard way and out the easy one. Then, if the

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route was a no-go, at least we'd waste minimum time. But from the way the subsurface looked on our scans, we appeared to be doing the reverse.

That, I would later realize was because Rudolph had no plans of doing his traverse, just as he had no plans of ending this thing as friends with Floyd. The only question was how it would end.

It would have been a lot easier if it had ended in failure. Then we'd have just collected our money, Rudolph would have gone home, and that would have been that. He might have wanted to do a second caving trip in a second moon, or go back to trying to tunnel around in clumps, but nothing in our contract said we had to do whatever he wanted forever.

Unfortunately, most of the trip wasn't all that hard.

The start was simply a matter of jumping into the sun cup. Even though it was a hundred and twenty meters deep, the gravity made it roughly comparable to stepping off a curb, and even though the thrusters were too bulky to take with us, Floyd and Rudolph would have no trouble leaping back out.

I've never seen actual vids of an Earthly talus cave, but I had a decent idea what they must be like: big bunches of boulders, piled higgledy-piggledy, over or under which you scrambled, climbed, or crawled, as the case might be. Here it was much the same, expect the boulders were ice, and low gravity added leaping as a viable mode of locomotion. Though *floating* might be a better description. We were in an underworld of big piles of angular ice blocks, incompletely pressed together. No giant, stalactite-encrusted rooms, no long, winding passages. Just a three-dimensional maze of cracks and gaps, some as big as GnuShip, some tiny.

Sometimes a big chamber would have lots of exits spidering off in every direction. Elsewhere, dead ends sparkled in Floyd's and Rudolph's suit lights. There were also chambers with only one or two narrow exits—black, shadowed holes leading toward places whose secrets seemed better unexplored. The CAT-scan map didn't have the resolution to spot things like that; all it could tell us was the direction to the next large cavity.

Unless you're a gerbil or kangaroo rat, talus caves on Earth are rarely navigable. You need big talus, with no small chunks. Otherwise, the small pieces block the passages, like the dust-bunny stuff we'd found in the clumps.

The surprising thing here was that we actually made consistent progress, albeit in a two-steps-back-for-every-three-forward fashion. Plus a lot of sideways. But even when we had to backtrack, we would eventually find a way through.

Most standard sims of planet formation, including moonlets like this, assume that a growing world scoops up a lot of little debris along with the big: snowballs as well as icebergs. More than enough to clog the pores. But this place was mostly comprised of big stuff. There was a bit of dust and small fragments, but most of it seemed to have been produced when moonquakes had caused boulders to grind against each other—one of those things I really didn't want to think about too much, though I'd run a thousand sims by then and concluded that quakes were common only on a geological timescale.

Still, any quake dust was disconcerting. But so was the lack of small rocks. It was just one more sign this place was weird. I kept trying to write sims that gave me a moonlet comprised only of icebergs. To make them work, they not only required the thing in the center to be dense, but to have arrived in Saturn System late in the game, when there were already plenty of big chunks for its gravity to attract.

It isn't a spaceship, I told myself. But there was something odd down there, and Rudolph seemed hell-bent on meeting it face-to-whatever.

Floyd was in his own world. When I

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tried to talk, he accused me of chattering. "There are no aliens," he said. "And all moons are weird. Name one that isn't. No, don't. I really don't want to argue about it." His vision shifted, swiveling his suit lights across the chamber we were crossing. "And these passages show no signs of gas ablation. There's no geyser down here that's going to zap us. This isn't Enceladus."

He didn't say anything, though, about getting squished. It's a lot easier to dismiss someone else's phobias than your own.

With all of that going on, I wasn't unhappy when, about three-quarters of the way down, we found ourselves in a chamber from which the biggest exit looked like a showstopper.

We spent an hour looking for other options, but good downward-leading passages were becoming less common as the weight of the overlying boulders mounted. The deeper we went, eons of moonquakes had crushed more and more passages flat or into narrow exits like the one we were now facing. Still, the CAT-scan map showed a nice, large chamber on the other side of this one, not all that far away, if we could get there.

Floyd was staring at the hole, thinking thoughts he didn't choose to share. He's a small, wiry type, and he was probably trying to gauge his chances of getting through. Rudolph was bouncing around the near-zero-gee chamber, still looking for alternatives, though it was pretty obvious it was this one or give up. Me, I was all for giving up. Let someone else meet the aliens. Or the moonquake.

I'm not sure what Floyd would have done on his own, but Rudolph was digging into his pack, and before his body shifted and blocked the view, I caught a glimpse of an odd-looking packet. I had no idea if he knew I was watching, but he'd given me enough of a glimpse. I froze a frame and did what I could to enhance it. I still couldn't quite read the text, but the package bore a couple of familiar-looking icons.

Again, I later realized that this should have been a sign that whatever Rudolph was after, he was willing to take huge risks to get it. But he'd already given me plenty of reasons to peg him as a cowboy, so at the time, I merely panicked.

"Whoa!" I yelled to Floyd. "That's explosive paste. What does he think he's going to do?"

I accessed what I knew of mining, which wasn't much. Still, the physics said that unless Rudolph was an expert—and he was a speculator, not an engineer—he was a lot more likely to seal us in or block the passageway entirely than to enlarge it.

Floyd snapped his head around, pinning Rudolph in his suit lights. "That's not a great idea," he said.

"I'm not turning back," Rudolph said.

Meanwhile, I was frantically searching everything I knew about caves: vids, books, etc. The vids were best, because even if they were totally hokey, I could watch how the actors maneuvered in tight passages.

I didn't like what I found, but Floyd wasn't going to win his argument with Rudolph, and Rudolph was the one with the explosives.

"Tell him we can probably get through without them," I said.

"Probably?"

"Yes." Or we'd get stuck and die. Not a great choice, but better than letting Rudolph play with the paste. "More likely than not."

I made Floyd take a really good look at the hole, while I did my best to calculate its diameter. "Yeah," I said. "I think you can make it. It'll be a little tougher for Rudolph."

The first job was to shuffle oxygen around between the storage compartments of Floyd's skinsuit. Calves and thighs were good: shoulders and back, bad. Luckily we had plenty of spare air in canisters that Floyd could push through ahead of us. The full backpack

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was just plain too big. Stupid thing to bring into a cave. Worse, there wasn't any rope—who needs it in near-zero-gee? That meant we had to push everything ahead of us, rather than drag it through behind.

"Okay," I said. "The trick is that your shoulders are the widest point. Reach one arm out in front and let the other trail behind, at your side. That way, you can angle your shoulders to fit through a pretty narrow hole."

I didn't have to tell him that this meant one arm was going to be trapped until the passage widened, and that if it never did, this was how he'd die. "If you still stick, we'll bleed off some air." I thought again about Floyd's parents. "Of course, there's no reason you have to do this. You can always let Rudolph be the guinea pig."

Floyd's vision swung around the cave. "No. I'm the guide. I go first."

A moment later we were on the move. Right arm ahead, pushing the supplies. Left arm trailing, soon pinned. Ice boulders pressing in on all sides.

And then, suddenly, I understood. "You know," I said, "you're not going to bring them back. And"—I wondered whether I should continue, but it was too late to back out—"they'd be proud of what you've become."

Floyd's inching progress halted.

"Brittney," he said, "this is a really bad time for psychoanalysis." Then, to the extent possible in that tight passage, he laughed, and I felt the tension that had been building between us for weeks ebb. "Even when you might have a point."

It's odd. In that moment, I no longer cared that we were virtually trapped, kilometers deep inside a too weird moon. Then Rudolph wrecked it. "Having fun in there?" he asked.

We had to bleed out a bit of air, but we made it. Rudolph had a tougher time, though, and getting him through put a bigger dent in our air supply. In vacuum caving, I now know rule number one: *when possible, keep air in bottles, not your suit*. Unfortunately, that's one of those things that's a lot more obvious in retrospect.

Still, we had enough left, so long as we didn't have to squander too much more.

Luckily, we didn't. Close to the center, we found dust, but not enough to block passages. It was black, in stark contrast to the boulders we were climbing over, around, and beneath.

Floyd scooped up a handful and held it close. This time, he remembered to shut off his suit mike. "Look familiar?"

"I can't be sure, but it certainly looks like Iapetus."

"So how'd it get here? Assuming it's the same stuff."

I didn't need to run any fancy sims for that. "We're tunneling backward in time. So, whatever dusted Iapetus must have happened at about the time the core of this place was forming."

The thought of Iapetus brought up memories of music, longing, and camping atop Rudolph's mons, but whatever I yearned for was better symbolized by going up and out, not in and deep. Here, there was merely darkness. Joseph Conrad territory: a story to savor in the reading, not the doing.

A couple of passageways later, we were as close to the center as we were going to get. Below us (to the extent "below" had meaning) was a black floor of . . . something. Something that looked a lot more solid than the labyrinth through which we'd been proceeding.

This close to the middle of most worlds there would be no gravity, but whatever it was that formed Daphnis' core was dense enough to exert some pull. Still, it took a bit of a shove-off to get us moving toward it. Even with the shove-off, *slowly* was the operative word.

If it was an alien spaceship, it was an old one. Its surface was pitted, as

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though it had been bashed, hard, by many things before accreting its iceberg mantle. Even without the pits, it didn't look like it had ever been smooth. For the first time, I truly didn't believe we had anything to worry about from aliens.

And then, finally, we were there.

It's not really possible to stand in anything lower than .001 gee. The usual approach is with a tethered expansion bolt. And since bolt guns work best at zero range, Floyd came in headfirst, ready to fire the moment the muzzle made contact. Pretty much standard procedure, except that when Floyd fired the gun, it and the bolt bounced.

He had it off to one side, or we'd have taken the full force of the rebound. As it was, he was able to let go of the gun, which drifted off somewhere behind us. He killed his tumble with an outflung arm and we wound up within a couple of meters of the surface.

With the hand thrusters parked all the way back at the entrance, we had no choice but to wait for gravity. Rudolph had come down behind us and shoved off—too hard, of course—to chase the bolt gun, and was still cursing somewhere above us when gravity finally began to do its thing.

As we drew near, I could see that the rock wasn't completely unscathed. Where the bolt had hit, there was a little dimple with cracks radiating outward. However hard this stuff was, it was brittle.

"Can you get a really good close look?" I asked. Floyd's middle-aged vision isn't what he'd like to think it is, and while my suitcam had a zoom, closer is always better.

I knew from the scans that the rock was as dense as granite, though not as dense as your typical nickel-iron asteroid. Now, magnified, I saw a glassy-looking surface with numerous tiny pores.

I'd once seen a picture of such a thing. "Holy smokes," I said. "I think it's—"

And then the picture turned to a blur.

It took me a moment to figure out what happened. One instant I was looking both through Floyd's eyes and the cam. Then the feed from his eyes flipped off and the suitcam jolted—first rushing toward the rock, then receding, with a starburst pattern in the lens, as Floyd's faceplate collided with the rock, then rebounded, mimicking the bolt gun. There were also noises: a thump, then a slow, deadly hiss that I could continue to hear, first through Floyd's ears and then, when I thought to tap into it, the suit mike.

My first thought was geyser. My second was that something had fallen on us. Except that down here, at near-zero gravity, it had happened way too quickly.

I didn't need the suit telemetry to tell me that Floyd was unconscious. The fact that I could hear through his ears merely meant the nerves and eardrum were still functioning. Unfortunately, I was the only one paying attention.

For a long time it might as well have been Enceladus repeated—long enough that I had plenty of opportunity to ponder the irony that Floyd's insistence on facing his own phobia had put me in too-intimate connection with the type of event that, whatever miracle it had produced the first time, was the thing I most feared. At least this time I wasn't blind. The suit lights still worked, though for 2.619 seconds, there wasn't anything to see except rock. Whatever had hit us had come from behind, and while Floyd's bounce off the surface had set us spinning again, it took that long for *behind* to rotate into view.

It's amazing how much time there is in two seconds. Normally, I adjust my thinking speed to match my environment. It's not that I actually alter my rate of data processing—that's hardwired into the chips. It's more like savoring a book or watching a real-time vid. It keeps me from overthinking and helps

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me carry on the type of conversation humans expect.

Now, I kicked into high gear.

You know how it is in vids when time seems to stop? That's how it is for me when I focus my attention. It's like having a week to think about what you're going to do or say next. Only in this case, there wasn't anything to do but wait for Floyd's body to rotate. The most useful thing was to write an algorithm to correct for the starburst pattern in the suitcam, once there was anything worth seeing.

What I finally saw was Rudolph, holding the bolt gun. The tether was a tangle, the bolt still snapping at the end of it.

Waiting, I'd had plenty of time to calculate the strength of the blow that had hit us. The bolt gun certainly fit, though if Rudolph had used it correctly, rather than from long distance, Floyd would now have the bolt in his brain and whatever game Rudolph was playing would be over. Though it looked pretty much over, anyway. I could see a spray of mist in the suit lights—ice crystals from the air leak, I thought at first. Then I amped up the zoom and saw red speckles on Rudolph's suit.

Luckily, the smart fabric in Floyd's skullcap was already plastering to his skin, sealing off the leak. That and vacuum cauterization would also stop the bleeding so well it would take surgery to detach the suit from his scalp. Assuming frostbite didn't get him first. Lots of spacers have survived big gashes on their arms or legs. A frozen brain is a different matter.

Not that we were likely to live long enough to die that way. Rudolph had found the tether release, and while the gun held only two charges, there were more in Floyd's pack. Even without them, the gun would make a dandy club. Right now, Rudolph was drifting, but as soon as he could, he'd launch back at us. I figured we had about thirty seconds until he got his chance—thirty eternities to think about it; not a lot of time to *do* anything. Maybe being able to watch death come at you wasn't so much better than not knowing, after all.

The first thing I did was to try to wake Floyd up. But people don't just snap out of major head injuries. It was up to me.

I gave myself two seconds to think through the conceivable options, plus several that weren't very conceivable: plenty of time to think, but not enough data to do much good. Rudolph had found what he was looking for and now he wanted us dead so he could keep his secret. He'd muffed it, which meant he wasn't a pro at killing. But still, he'd preferred killing to trying to buy our silence, which meant he was either determined not to share or not sure we'd keep our end of a bargain. I had to give him no choice but to bargain.

I wasted ten more seconds trying to link into his suit processor. There were only about a thousand channels on which the thing could be operating, but channel flipping is something you can only do in real time, and I flipped through about four hundred before I scored.

When I finally got in, I found a stripped-down version of the guardian I'd encountered on his capsule system. I should have expected it. Rudolph was a security freak. Even his backpack had a radio-controlled voicelock. Its frequency had been number 226 on my trial list.

Rather than dodging the mini-guardian, I let it catch me—well enough to sound an alarm, but not enough for it to bar the door. Then, just when telltales should have been flashing on Rudolph's goggles, I accessed Floyd's radio. "If you want to live, drop the gun, now!"

My suitcam was rotating out of view again, but I could see Rudolph jump: Shackleton revisited. He writhed like a cat, trying to see what was behind him. Earther reflex, I realized. A voice comes out of nowhere, you look behind. In all the scenarios I'd played through, that wasn't a reaction I'd anticipated. Spacers

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avoid sudden moves.

"Who are you?"

Another thing I'd not anticipated. Who the hell did he think I was? ET? He'd known all along the thing at Daphnis' core wasn't a spaceship.

He figured it out quickly enough, though. "You're that Brittney thing, aren't you?"

There are times not to argue about word choice. If I got out of this alive, perhaps it was time to give myself an extra year's maturity. "Yes."

"Maybe I should just cut you out of him and take you with me."

That meant the bolt gun wasn't the only weapon he had. For once, something didn't surprise me. He had to have had *some* plan in mind until the gun came into his hands, and even the toughest skinsuit fabric wouldn't stop a good knife. I wasn't sure whether the fact he'd given that away so easily was another sign he didn't really respect me, or simply that he wasn't good at murder: ruthless in business, not with his hands—probably why he'd tried to use the gun from long range. Unlike the books and vids I'd chosen to mostly forget, the ones I'd savored had convinced me that most humans find it easier to kill at a distance. Cornered, though, Rudolph would be a lot less squeamish.

By now, I was far enough off my game plan that all of my scenario planning was useless. I split my perceptions so I could talk colloquially, in Rudolph-time, while continuing to think in the background. "You wouldn't survive that," I said.

Another thing I've learned from vids is that threats are useless if you can't convince people you can carry them out. I'd shut down Floyd's medical telemetry so Rudolph couldn't see what bad shape he was in, but as far as I could tell, Rudolph didn't need to hit him again. He could just leave us here. Even if Floyd did wake up before the frostbite got too deep, he'd never make it back to the surface. Somehow, I had to persuade Rudolph to help us.

His suit's miniguardian wasn't as good as the one on his capsule, but only I knew how scary its big brother was. This one was mainly designed to guard data files he'd loaded onto his suit system—maps, CAT scans, and whatever else he thought was important enough to have along. So I bypassed it and attacked the suit: shutting down his lights; spiking, then constricting, his oxygen flow; altering sensor readings. Then—a showboat move, but I might not get another chance—I popped the lock on his backpack.

"That's just a sample of what I can do," I said while Rudolph was putting his suit on manual override. "I can also"—this time, I let the guardian catch me so Rudolph could see it happen—"erase your files. Starting with the map."

"You little bitch. . . ."

"I'll take that as a step up from 'Floyd's thing.'" There wasn't really any reason to say that, but it felt good. It also distracted him from realizing that however convoluted the route in had been, he might be able to puzzle it back out without me. And unfortunately, there was a limit to what I could do to his suit; those things were designed to be failsafe. I needed something else to make sure he believed he had to keep us alive.

The guardian and the locked backpack gave me an idea.

"Floyd's too trusting," I said. "Before we landed, I left a copy of myself on the ship. If Floyd's suit doesn't come back with him in it—the medical telemetry showing him alive and mendable—it has no reason to wait around."

"You're lying."

"Computers don't lie." Which was both true and not true. Computers do what they're told. But I'm not a computer. I may live in one, but I'm the one who does the telling. I was gambling that Rudolph didn't understand the difference. Floyd had enough trouble with it.

Still, I was almost surprised when he

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gave in. It wasn't just the lying thing: if he'd really understood me, he'd have known there could be no copy. But people can't quite comprehend an entity like me. Even Floyd probably thought I could simply flow into the web, like some kind of worm. But it's not that simple. Even a worm can't just dribble though a link, like water down a pipe. It copies itself.

Technically speaking, I could do that, too. But the only way to actually move would be to erase the original. Which, if you're the copy left behind, kind of defeats the purpose. To do it, you'd have to be suicidal, murderous, or both—in which case, you're not worth copying.

Maybe, in some circumstances, it would be like sacrificing yourself to save a child. But the child would simply be another me, so that isn't the greatest of analogies. Besides, before I went sentient, I was a fairly standard AI. That meant I was copy-protected. There's a protocol for a transfer—that's how Floyd got me—but it involves a reboot, and I have no idea whether there'd be a *me* left afterward.

Luckily Rudolph wasn't thinking along those lines.

"What about this?" he said, gesturing to the black surface below us.

"What about it? You found the mother lode."

"Yeah?" He knew I understood. He was just testing to see if I would lie.

"It's carbonado. Black diamond. Trillions of carats. Maybe more." Black diamonds are one of those fun things life is so full of. I'd read about them during one of my long nights of web sifting. They're not worth much as gemstones, but like diamonds of any type, they've got a lot of industrial uses.

On Earth they're only found in Brazil and West Africa. One theory held that way back before there was an Atlantic Ocean, that part of Pangaea got hit by a diamond asteroid: part of the core of something or other. Something like a missing moon of Saturn—or more likely, a piece of the exotic interstellar debris that had clobbered it.

I had to hand it to Rudolph; going to Iapetus to check the theory was a pretty bold move.

Prior surveys must have found diamond traces in the dust—even ordinary meteorites are riddled with nanodiamonds. But they're only a few thousand atoms in size, and common enough that nobody would pay much attention.

Most of the dust must simply be ordinary rock, or the diamond hunt would have been on long ago. But hiking around Iapetus, Rudolph had not only been setting up his vacation-trip cover, he must have been hunting for traces of bigger game—signs that it would be worth his while to speed weeks poking around the Rings in hopes that bigger chunks might still exist.

Now that he'd found one, his problem was that it was hundreds of times larger than all the diamonds ever produced on Earth, combined. A few tons a year would be worth a fortune. The whole thing would crash the market. And the Rings are a big place. If people knew that one of these existed, they'd look for more, and if the raisin-sprinkled clumps we'd found meant anything, there might be a lot of them.

What I wanted to say, was *big deal, it's just money.* Beyond some level, who needs it? But Rudolph clearly wasn't going to understand that any better than why I wouldn't leave a copy of myself on GnuShip. We were alien enough to each other that we might as well be ETs out in the Oort Cloud.

The bottom line was that Rudolph's long-shot prospecting trip had paid off, big. But only if nobody blabbed. I don't know what it takes to drive the average ruthless speculator over the line to murder, but I now knew the answer for Rudolph.

That meant I had to speak his language.

"Ten percent," I said. Floyd and I had a better chance of getting out alive if

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Rudolph believed we had a vested interest in helping him keep his secret.

"One. Can you speak for Floyd?"

"I've got his power of attorney." What was one more lie? Besides, if we got out of this alive, it wouldn't be a lie for long. "Five."

We settled on three, with a three million advance. I probably could have gotten more, but I didn't want him trying too hard to worm out. Of course, I had the whole thing recorded, along with plenty of evidence to convict him of trying to kill Floyd. But if I got greedy, he'd claim file tampering. If I'd been a pushover, though, he'd have assumed I was waiting to turn him in. Three percent seemed about right. Besides, I was in a hurry; I needed Rudolph's help to patch Floyd's suit.

If Floyd survived, I'd traded away his right to justice for riches. Sometimes you have no choice but to make a deal with the devil.

Getting back to the surface posed a different sort of problem. Rudolph wanted to go back the way we'd come. With Floyd conscious and able to help, I'd have agreed. But I had serious doubts he was waking up soon. If ever. That meant we'd have to try Rudolph's explosive paste to get through the tight section. If it didn't work (and if we hadn't managed to seal ourselves completely in) he'd have nothing to lose by trying for the surface alone—and I couldn't stop him. The other direction might have a dozen tight passages, but without a map, Rudolph couldn't panic and run on his own. What this meant was that I needed to keep him more afraid of me than of the unknown.

A long time ago, Floyd had asked if I had an avatar. I'd offered several, but he hadn't liked them. Now, I needed something more commanding than my (now) twenty-one-year-old self-image. I flashed through vid memories, plus novels of the Galactic Space Corps, Androids of the Asteroids, and all the other fun stuff that presumably taps into a universal human subconscious. Unfortunately, mostly it was the wrong part of the subconscious. There were lots of women, but they tended to be improbably proportioned. When I finally found something more suitable, she had pointy elf ears. Another had blue skin. Still, when I edited out the alien features and crossed the result with a couple of prime ministers, I had something that might make Rudolph see his mother, back when he was the right age to have either loved her or feared her. Zeus on estrogen. Probably not a good thing to show Floyd.

I have no idea what Rudolph thought of my avatar; but it couldn't have hurt my case, which was basically *I'm in charge, and we're doing it my way.*

It also turned out to be the right way. There were a few tight passages, but none as bad as what we'd seen, and all surmountable by the simple expedient of having Rudolph shove Floyd through ahead of him, like a big backpack. Two were tight enough that he had to leave his own pack behind and go back for it, but we got through easily enough.

The main difficulty was that the moment he regained contact with his capsule, he was going to discover that there was no other me waiting to keep him out. His suit probably had the better radio, and I didn't want to risk him locking me out of GnuShip while I was still out of contact.

Give me enough data, though, and I can run a sim on just about anything. In this case, I merely needed to track our progress and time it so we reached the surface while GnuShip was below the horizon. Then I made sure Rudolph was busy with a thruster burn when she rose into line of sight. A quick ping, and I had a dummy program up there that could do a pretty good imitation-Brittney, so long as I fed it instructions. Not that it takes much to fool someone who's never taken you seriously, but it was nice to keep him believing I was simply a ma-

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chine that couldn't lie. Though by that time, I really did have full control over GnuShip, and she definitely wasn't going anywhere without me and Floyd.

We wound up in the Iapetus Base hospital, where Floyd was diagnosed with a depressed fracture of the occiput and subdural frostbite. A few minutes later with the suit patch, and he wouldn't have made it.

Frontier medicine leaves a lot to be desired, but the base was well stocked with stem cells, and Floyd proved an easy match.

Rudolph paid an exorbitant fee to catch the first in-system e-rail boost and was gone even before the medic finished scraping out the dead parts of Floyd's brain. I let him go. People have an image of the wild frontier, but there really isn't that much crime out here, and what there is, is usually handled by—I guess the term would be *enforced negotiation*. Who wants to waste hab space on a jail? Though I suppose you could boost convicts in-system and let Earth handle it. If I were the vindictive type, I could make Rudolph regret his abrupt departure, but I was too glad to have him gone.

Harder to deal with was Floyd's recovery. A stem-cell bone fusion is a simple procedure, but it takes weeks to mature. Meanwhile we were stuck in a guest hab. Though at least Rudolph's millions meant I'd never lack for library fees.

Brain regeneration is even slower than bone regeneration. And trickier. Floyd had mostly lost motor abilities, and when the stem cells were slow to patch the loss, the medic installed a neurolattice chip to help fill the gap. Unfortunately, this was a field where frontier medicine really lagged, and the chip had an ultra-slow processor that was better than nothing, but not by a lot. The medic said that until the new neurons grew into it properly, Floyd wouldn't be able to walk. Then she said he'd never walk without a limp. Then she quit making guesses.

What I didn't see any reason to tell her (or Floyd) was that as long as she'd left the chip's telemetry on, I could assist it.

I'd always wondered what it would be like to have legs. I think you have to be born to it. Muscles aren't servos. Tell a muscle to flex x degrees, and maybe it will, or maybe it'll do x minus one or x plus three. If that's what the skill thing is about, Floyd can have it.

Floyd had a different view of Iapetus Base medicine than I did.

"Crap," he said when he was starting to feel recovered enough to be his usual grumpy self. "This place is getting as civilized as Jupiter. When I came here, they'd have just patched me up, put me back on the ship, and told me to go heal myself."

"And you might well have died."

"Yeah. Don't get me wrong. I'm not ungrateful. It's just starting to feel too much like the Inner System. Give it another few annums and we'll be hip deep in—I don't know: department stores and wine bars. Hotels with room service."

"So?" Though I was pretty sure I knew.

"That kind of stuff makes me twitchy. It's like being under all those rocks in the cave."

It was the most he'd said about the cave since we'd gotten back. Partly because he had no memory of being attacked by Rudolph. No memory of the big diamond. The last thing he could recall was laughing in the embrace of the tight squeeze. Not a bad place for his memory to blank out, I suppose, but until now, he hadn't wanted to talk about that, either.

Now I couldn't decide if I was angry or curious, counselor or partner. Or just his "damn imp." But I did want to understand what had driven him into the caves. It had nearly gotten both of us killed.

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"Take me back to Mount Zebra," I said.

Even with my help, Floyd wasn't ready to hike, though he was doing better with less and less assistance. In a few weeks he might not even need me. If he ever really needed me at all.

It wasn't until we stepped out of the skimmer that I knew why I wanted to come back.

We'd wound up on Rudolph's mons rather than Mount Zebra because it offered the only skimmer-sized flat spot in the vicinity. That was fine: Rudolph was the bad memory, not his mountain. It was at its base that I'd felt the yearning: here on the summit that I'd felt the sweep of where yearning wants to lead. Getting to the top had been utterly meaningless in any grand scheme of things—and utterly meaningful on the Brittney scale of the world.

Then I'd lost it all in the cave.

This had been clean. This had been good. The cave had been something else.

"Why?" I asked.

If Floyd had chosen to play dumb, I think I'd have made my decision, right then. But he didn't, at least no more than the ambiguity of my question required. "Why which?"

"Start with the cave."

We stared out over the Trench at the hanging face of Saturn. For a moment, he was lost in thought, but I'd grown up enough to know he needed time. Just as I did, actually. Time is thought, but sometimes it is also data. It was something I'd learned from Floyd. In a place like this, the data is the view, which must be savored for the thought to be meaningful.

"Partly, I've always wanted to know what it was like," he said. "Their last moments, that is." There could only be one *they*. Floyd never referred to his parents directly—rarely referred to them at all, in fact.

"But?"

"Mostly, I wanted to know if I could handle it." He stared some more. "If you're afraid of something, you ultimately have to face it. Otherwise, you obsess about it." He gave a bit of a half laugh. "Like you and T. R."

"Except that I was *right.*"

This time he did laugh. "Yeah, I have to give you that." He was looking at the Rings now. "But I was right, too. Not about T.R., about facing the cave. Maybe sometime I'll remember the whole thing, but I remember enough. I went into that tunnel. Obviously, I got out the other side, or I wouldn't be here. That was what I needed: to find the other side."

It was about as long a speech as I'd ever heard him give, but it wasn't enough.

"How does that relate to luxury hotels and all that other stuff?"

"I'm thinking it's time to move on. Uranus has rings, lots of moons, and a couple hundred people who are going to need a tug. Not that we need the work if Van Delp comes up with even a fraction of the money you twisted out of him."

"He will." If he reneged now, I'd make sure the whole System knew about his diamond.

"So maybe we should get a jump on folks and head on out to Neptune."

"Just like that?"

"Well, we'd need to line up an e-rail boost. And lay in supplies here, where they're cheap."

"But what's that got to do with caves?"

Floyd scuffed at the rocks with his gloved hand. I left the chip alone, and he did pretty well on his own. He didn't really need me. He'd be an athlete again, soon enough, and never know how much I'd helped.

"I'm starting to feel surrounded," he said. He picked up a rock and turned it over and over in his hand. "Too many people, pressing at me from all sides. In the cave, I could just say, 'Okay, this is temporary.' But this will only get worse. It makes me feel trapped."

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"Maybe that's what you really needed to face."

He threw the rock as hard as he could. Sloppily, not quite in the direction he intended, in a flat trajectory that, in the low gravity, took a long time to dip out of sight.

"Maybe someday." He picked up another rock and threw it, too. Better this time, though still a long way from perfect. But it looked like the new neurons were finally growing into the lattice. "But not yet."

"I'm twenty-one, now," I said.

Floyd's heart rate had picked up as he talked of being trapped. Now it jumped again. "Are you going to leave me?"

I wondered if he understood what that meant: an operation, not just me trickling away over the net. The chips would have to be physically removed, with me up and running for the ride. But I never doubted he'd let me go if I asked.

Even if I left, I'd still be bound to him. Legally, I really was just a thing: Floyd's imp, with which he could do what he liked. If he didn't maintain the appearance of ownership, someone would try to claim me as salvage. But he wouldn't try to hold me back. He was too much the individualist to refuse the same freedom to someone else, even if she was nothing but electromagnetics, will, and dreams.

So what did I want?

"Yes." I said. "No. Damn it, I don't *know.*"

I sought data again from Mount Zebra, Saturn, the Trench, everything beyond—but there was nothing new. What *did* I yearn for? A robot body? It would have to be custom made, or I'd wind up a repair drone or worse. Become BrittneyShip? I'd be a good tug pilot: no need for life support, no need for food. Half of Rudolph's money would be mine, and with Floyd heading out-system they'd need a tug around here. I'd have enough to buy one.

Or I could go in-system. I'd always wanted to see Earth—in the real, not merely by vid. The software firm that originally wrote my code had been based there, but I don't remember it. I wasn't activated until I was installed in the manager of a volatile plant on Io—the guy from whom Floyd got me a few annums later.

So, what did I want? To fly? To be free? To do what *I* wanted? It's what half the vids I'd ever seen were about.

"You don't have to decide now," Floyd said.

He was right, but for some reason it merely provided a focus I'd not found in the distant horizon.

"Yes I *do.*" I thought of all the vids I'd seen of women stamping their feet. Maybe having a body did have certain advantages. "Part of it, anyway. You treat me like a precocious child. But I was always more than that, and now I'm grown up."

Floyd was again silent for a long time—though my thought-processing speed was now in crisis mode, so several thousand milliseconds seemed like forever.

"I did kind of drag you into that cave, didn't I?" he said.

"Damn straight," I said, surprising us both with my vehemence.

This time, the forever stretched for several seconds. "It's your choice," he said. Another forever, longer yet. "But I'll miss you." Another pause. "And I've never before said that to anyone, ever."

Later, I was never sure how close I'd come to leaving. All I knew was that I felt like I was wandering through my own cave, without a map. I had been formed by a miracle. I owed it to the miracle—God, if you like—to make use of it. BrittneyShip would be fun, but was that the best use? I'd just wind up another Floyd, plying the Outer System all by myself. With Floyd, my uniqueness was doubled. And I'd miss him, too.

"If I stay, I need to be treated as an equal. Ties don't go to the one with legs."

The suitcam bobbed: Floyd nodding

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to himself. "Yeah." More silence. "So that means you don't want to go to Uranus."

"I didn't say that. I just wanted to be asked."

Someday, I really want to go to Earth. But it didn't have to be today. That was the message in the view. It changed, it evolved, it *grew*. But not instantly. For now, life still has a lot of interesting things to offer out-system, as well as in. And who knows, maybe someday, when I've grown to the point that I need to balance the out with the in, Floyd will be ready, too. If not? Well, he and I both have a lot of milliseconds in which to figure that one out. ■

(EDITOR'S NOTE: Floyd and Brittney appeared earlier in "The Sands of Titan," June 2007.)

IN TIMES TO COME

Our two annual double issues always offer plenty of "extras," and this year's July/August issue features something especially extraordinary. Back in the early 1980s a completely unknown writer named David R. Palmer made a huge splash here with his very first story, "Emergence," featuring Candy Smith-Foster, one of the most memorable people many of our readers had ever met on or off the printed page. But she's much more than just a remarkably talented little girl emerging from the ashes of a worldwide genocidal war: she's one of the first of a new species "just like us only more so," emerging into the world as a delayed result of a historic plague. "Emergence" was followed by one more story here, then grew into the acclaimed novel *Emergence*. Now *Emergence* has a worthy sequel, *Tracking*, in which Candy discovers that, devastating as past events were, they weren't as finished as she thought. So naturally she has to set forth to Do Something About It, and we're proud to present her further adventures as a three-part serial beginning next month.

Carl Frederick, well known in various circles as both science fiction writer and physicist, appears as both next month, with a fact article on "The Challenge of the Anthropic Universe" and also the novelette "The Exoanthropic Principle." Certain physicists lately have been debating which of several hard-to-swallow hypotheses are the least hard to swallow; Frederick's article surveys the ideas, and his story explores the implications if some of them turn out to be right.

Rounding out our oversize issue we have another of Richard A. Lovett's special features about writing (this time dealing with story beginnings), and an assortment of fiction by such writers as the perennially popular Michael F. Flynn, Maya Kaathryn Bohnhoff, Jerry Oltion, and a promising newcomer or three, covering a wide spectrum of length, subject matter, and flavor.

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Science Fact

Peroxide Snow, Ejected Moons, and Deserts That Create Themselves

Richard A. Lovett

A popular subgenre of science fiction is world building, in which authors attempt to create ecologies, planets, and solar systems different from any we know. Such stories need to be scientifically plausible, logically coherent—and as exotic as possible. There's just one catch: the real universe keeps serving up ideas nearly as strange as any we've imagined.

In this article, we'll look at a smorgasbord of recent theories, starting with one of the best-known alien worlds: Mars.

Dusty Death on the Red Planet

Mars is dusty. It's also, on occasion, windy. Not only does the thin Martian atmosphere generate winds strong enough to raise enormous dust storms, but it can also create dust devils: swirling vortexes that can tower several miles high and a quarter-mile wide at the base.

Dust devils aren't tornadoes, but Earthly ones can pack enough punch to knock you off your feet. On Mars, they've helped cleanse the Spirit and Opportunity rovers' solar panels of light-blocking dust, dramatically extending the rovers' operating lives. Now, scientists think the dust devils are also generating snow: not like any we've ever seen on Earth, but fluffy flakes of corrosive chemicals that settle into the planet's soil, sterilizing it of any traces of complex organic matter.

One of these chemicals is hydrogen

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peroxide, produced by the build-up of static electricity in the swirling dust.

Earthly thunderstorms generate static electricity by a similar process involving ice particles high in the atmosphere. "We think the same thing occurs on Mars, but instead of ice, it's dust," says Gregory Delory, a physicist from the University of California, Berkeley, whose team spent years chasing dust devils across the Arizona desert with a special, instrumented truck.[1] "It's analogous to rubbing your feet against a carpet."

The static fields aren't strong enough to produce sparks or lightning, but they do promote chemical reactions. Water vapor (a major constituent of the Martian atmosphere) can be dissociated into H+ and OH- ions. Carbon dioxide (also prevalent) can break down into carbon monoxide (CO) and atomic oxygen (O). "Once you do that," Delory says, "it's like turning the oxidant-production mechanism into overdrive." The result is a smorgasbord of byproducts, including enough hydrogen peroxide (H_2O_2) to fall to the ground as snow.

This explains a conundrum dating back to 1976, when the first Mars landers, Viking 1 and Viking 2, failed to find any trace of organic matter in the Martian soil. Hydrogen peroxide (commonly used as an antiseptic on wounds) is a potent oxidant that rapidly destroys organic matter.

Even if Mars never held life, the lack of organics in the soil was puzzling. "Organic material has been raining down from meteorites and comets for four and a half billion years," says Sushil Atreya, director of the Planetary Science Laboratory at the University of Michigan.[2] "So where is it? Something must be oxidizing the organic material."

The idea that hydrogen peroxide might be the culprit isn't new, but until now, the only known mechanism for creating it was decomposition of the Martian atmosphere by ultraviolet light from the Sun. That undoubtedly occurs, but it doesn't produce much peroxide. That which it does produce is high in the atmosphere, where it would last only a day or so before it, in turn, is destroyed by sunlight.

Dust devils, on the other hand, can produce hydrogen peroxide up to 10,000 times more quickly, Delory and Atreya calculated: right near the surface where it can easily reach the soil. "Once it gets into the surface, it can last for years," Atreya says. "Some calculations indicate it could even last for 10,000 years."

That makes for some extremely oxidative soil, capable of destroying all organic matter in the manner observed by the Viking landers.[3]

The finding has enormous implications for the search for life on Mars. To

[1] Delory is lead author of one of a pair of articles on the subject, published in the June 2006 issue of the journal *Astrobiology.*

[2] Atreya is lead author of the second *Astrobiology* paper.

[3] In a new development, a paper in the October 23, 2006 online edition of the *Proceedings of the National Academy of Sciences* by a Mexican team led by Rafael Navarro-Gonzalez, found that Viking's sensors may have been blind to low levels of organic matter, such as that found in some of the Earth's own harshest environments. This doesn't mean, however, that there *is* organic matter in the soil or that peroxide isn't present. Unfortunately, no lander to date has been designed to test for hydrogen peroxide.

It's not clear, incidentally, whether the chemicals in the soil might pose problems for future astronauts' equipment. "[Hydrogen peroxide] is obviously not present at a level that is corrosive to something like the Mars rovers," Delory says. "Though you never know—they did have a wheel get stuck." And, he notes, there might be problems for equipment remaining in contact with the soil for many years.

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begin with, one potential sign of life on other planets is the presence of methane in the atmosphere. Methane can be produced by either organic or geological processes, but on Earth, the vast majority comes from biological sources. "So if you're looking for life, one of the first things you want to look for is methane," Atreya says.

Normally, atmospheric methane would persist several hundred years before sunlight destroys it. But hydrogen peroxide would destroy it much more quickly.

What this means is that any methane in the Martian atmosphere (and there is some) represents a much stronger source than had previously been thought, whether that source is geological or biological.

If there is life, Atreya thinks it's likely to be well beneath the surface, probably 2,000 to 10,000 meters down. That's far below the peroxide zone—and deep enough that the planet's interior heat might allow liquid aquifers.

Of course, there could be peroxide-tolerant life closer to the surface. "We can't say how life would adapt," Delory says. "The best we can say is that [the Martian surface] is inhospitable to most life as we know it. It's not inconceivable that there are forms of life that thrive under those conditions."

Lose One, Gain One

From Mars, let's move farther out to Triton, Neptune's largest moon.

Triton is one of the oddest bodies in the Solar System. It's big, as moons go: forty percent more massive than Pluto, an object that in many ways it resembles. Its orbit is tilted 23 degrees from the plane of Neptune's equator. And it orbits backward, or "retrograde," compared to every other large moon in the Solar System.

Astronomers have long speculated that this means Triton and Neptune haven't always been paired. Triton appears to be an interloper, somehow captured by Neptune's gravity. The difficulty has come in figuring out how this might have occurred. Contrary to many science fiction movies, an object coming close to a planet isn't easily captured: something has to slow it down.

One possibility is that, eons ago, Triton smacked into one of Neptune's other moons. But the odds of such a collision are small. Another possibility is that it passed through a band of gas extending outward from Neptune and was slowed by aerodynamic braking. But it would take a lot of gas to accomplish this, and once Triton was captured, the braking would continue until its orbit decayed, unless the gas dissipated very, very quickly.

A paper in the May 11, 2007, issue of *Nature* has come up with a much more feasible capture mechanism, based on recent discoveries in the Kuiper Belt, a far-flung region of the outer reaches of the Solar System where dwarf planets slowly circle the sun. About 1,000 Kuiper Belt objects are now known, including Pluto. The biggest, once dubbed Xena but now called Eris, measures 2,400 kilometers in diameter (compared to Pluto's 2,300 kilometers and Triton's 2,700). Other sizeable bodies are Sedna (1,500 kilometers), Varuna (900 kilometers) and Quaoar (1,200 kilometers).

Interestingly, about ten percent of the Kuiper Belt objects are binaries. Pluto itself is one of these pairs, orbited by a companion, Charon, that is a full one-eighth of its mass.

The new study, by Craig Agnor, a planetary scientist at the University of California, Santa Cruz, and Douglas Hamilton of the University of Maryland, proposes that Triton originated as a member of another Kuiper Belt pair. As the two small worlds approached Neptune, Neptune's gravity yanked them apart, slowing one enough to be captured while flinging the other off into space.

Agnor and Hamilton tested their idea by computer models in which Triton

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and a companion approached Neptune in various manners. "We don't know the exact mass of the escaping object," Agnor says, "but things like those observed in the Kuiper Belt seem to work." Better yet, the new theory doesn't require any vanishing gas belts or low-probability collisions. "All you have to do is get close to the planet," Agnor says.

The Desert that Might Have Created Itself (But Probably Didn't)

Let's now return to Earth for a bizarre-sounding theory about the formation of the world's driest desert: a region where, in some places, no rain has ever been reported.

Deserts form when something screens them from sources of moisture. America's deserts, for example, lie downwind of mountains that wring most of the water from the clouds as they cross over.

The super-dry desert is the Atacama, which spans a big chunk of Chile, downwind of one of the world's biggest mountain ranges, the Andes. One theory is that the desert is so dry because the mountains, rising more than 20,000 feet, have cut off *all* of the moisture. But there's another theory, which says the desert may have aided in the formation of the mountains—exacerbating the process that made it dry, in a runaway feedback mechanism.

To understand this, we need to begin with a primer on Andean mountain-building. Off the coast of South America, the Pacific Ocean's Nazca Plate is being forced beneath the South American Plate in a long, slow collision. One result is that the South American Plate has buckled upward, east of the line of collision, to form the Andes. In the U.S., similar forces played a role in the formation of North America's western mountains. But there's a difference: in South America the prevailing winds blow from the east, rather than the west. That puts the desert on the coastal side of the mountains, rather than inland, like America's Mojave, Sonoran, and Great Basin deserts.

This difference in wind direction is potentially important, because the height of the Andean bulge should be affected by the "stickiness" of the fault between the Nazca and South American plates. The better lubricated the fault is, the more easily the Nazca Plate slides down and the less buckling there should be in the South American Plate.

One way to lubricate a fault is with sediments washed off from the continent. But in a desert, there's little rain and therefore little sediment. The result: a lot of buckling.[4]

Thus, while the desert might have been created by the mountains, it might also have come first, increasing the size of the mountains that would otherwise have formed.

To test these alternatives, Adrian Hartley, a geologist at the University of Aberdeen, set out to compare the ages of the desert and the mountains.

The Andes appear to have started forming 25 million years ago, but most of the uplift has been in the past six to ten million years. The desert is a bit harder to date, but Hartley has found several ways to track moisture fluctuations in the region. By examining sediments in dry lake beds, for example, it's possible to determine whether they are "evaporites" laid down by infrequent rains or melting snows, or "fluvial" deposits created by perennial streams. It's also possible to analyze pebbles to see how long they've been exposed to cosmic-ray bombardment, an indicator of how long it's been since there was enough rain to wash them away.

Other desert-dating methods involve studying erosional landforms and looking for signs of waterborne minerals

[4] This could also be why Chile is prone to devastating earthquakes, with one in the 1960s that was even bigger than the temblor that shook Sumatra in 2004. When sticky faults slip, they slip violently.

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leaching into the subsurface rocks—something that only happens in a certain range of climate conditions.

Hartley's finding: there have been wet and dry interludes, but the desert neither created the mountains nor was formed by them. Rather, it was there before the mountains, and changes in it and the mountains are not well correlated. More likely, he says, its history is related to changes in global ocean currents, perhaps driven by changes in the Antarctic icecap.

Too bad. But this doesn't mean a self-creating desert is impossible. It just doesn't seem to be the case for the Atacama. On some other planet? Who knows . . .

Shrinking Alps

Scientists have had better luck with a theory about the Alps and the Mediterranean Sea.

This theory relates to the Mediterranean "salinity crisis" that began about six million years ago and lasted for about 600,000 years. During that interval, the Strait of Gibraltar became a land bridge, cutting off the Mediterranean from the Atlantic Ocean. Because many of the lands draining into the Mediterranean are relatively dry, the Mediterranean's sea level dropped by hundreds or even thousands of meters, as evaporation exceeded influx.

One result was the conversion of the Mediterranean into a much-shrunken, very salty inland sea confined to a basin much farther below sea level than anything currently on Earth. That's interesting enough in itself, and was the topic of Harry Turtledove's Hugo-winning alternate history novella, "Down in the Bottomlands" *(Analog,* January 1993). But Sean Willett, then of the University of Washington, and two European colleagues have suggested that the salinity crisis affected the growth of the Alps.

The Alps are the result of the northward motion of Italy, compared to the main body of Europe.

People tend to think of mountain building as a process in which mountains rise continually, until the tectonic forces building them cease. But actually, it's a tug-of-war between uplift and erosion, with some interesting feedbacks between the two processes. Bigger mountains, for example, generate more rain and more glaciers. And taller mountains are drained by steeper streams, with greater erosive power. The same process also affects the width of a mountain belt.

One result is a feedback loop in which mountains tend to grow to the size at which they're eroding just as fast as they're rising. Another is that the size of a mountain range can change if something alters the balance between growth and erosion.[5]

In the case of the Alps, the Mediterranean salinity crisis may have produced a huge change to the balance between mountain building and erosion.

Six million years ago, the Alps were at their maximum extent, perhaps 100 miles wider and 5,000 feet taller than at present. Then they began to shrink. It's possible, of course, that this could simply reflect a change in tectonic forces. But in a study of erosional deposits in Italy's Po River Valley, Willett's team found signs of a large increase in the rate at which the mountains were eroding.

In an article in the August 2006 issue of the journal *Geology*, Willett and coworkers attribute this to the change in sea level in the Mediterranean. Although the coincidence in timing is only circumstantial evidence, the theory makes sense because the enormous drop in sea level would force the rivers to drop thousands of extra feet to reach the sea. It wouldn't take them long to start carving big canyons that would

[5] For an elegant, detailed description of this process, see John McPhee's classic geology book, *Basin and Range*.

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soon begin stripping away the mountains at their headwaters.[6]

When the Mediterranean refilled, however, Willett's team found that the Alps continued to erode more quickly than before. In this case, the cause appears to have been a climate change that had nothing to do with the Mediterranean. About five and a half million years ago, the Earth moved out of an extensive series of ice ages. This would have warmed the Atlantic Ocean, changing Europe's climate and increasing rainfall. At the time, the Mediterranean was still an inland sea far below sea level, but the increased rainfall would have dealt the Alps a second blow—one that continued, even when the Mediterranean regained its connection to the Atlantic and rose back to its present level.

CAT Scanning a Volcano

Erosional and plate-tectonic processes, of course, work on an extremely long time horizon. To the extent that humans (or aliens) of the future will be interested in harnessing them, it would have to be in the realm of very long-term terraforming, where they would have to be aware that changing the climate might have unexpected geological consequences.

Other geological processes occur much more quickly.

The 2005 Discovery Channel feature "Supervolcano" involved a hypothetical eruption of the volcanic plume beneath Yellowstone National Park. Science-fictionally, one of the most interesting aspects of the feature was the way that volcanologists of the future were shown using a powerful computer to create three-dimensional holographic displays of magma movements, beneath the Earth.

The movie was set in 2025. But in a paper in the August 11, 2006, issue of *Science*, a team of seismologists was able to do a stripped-down version of what the movie depicted, tracking magma movements beneath Italy's Mt. Etna, which has been intermittently active for many years.

The Italian scientists used an array of forty-five seismic stations positioned on the slopes of the 11,000-foot volcano. These stations recorded more than 2,500 earthquakes during an eighteen-month interval, including one unusually violent eruption. Before-and-after maps of the mountain's interior were then made by comparing the speed with which the seismic waves reached each of the seismometers. Different speeds meant that they were passing through different types of rock, including magma. By assembling this data in a manner similar to that used for medical CAT scans, the team, led by Domenico Patanè of the Istituto Nazionale di Geofisica e Vulcanologia, in Catania, Italy, was able to map the mountain's interior to a depth of five kilometers. Not only were the scientists able to spot the arrival of a new batch of magma beneath the mountain, but they were able to determine, from the speed with which the seismic waves passed through it, that it was rich in carbon dioxide, a major cause of explosive eruptions.

In essence, the scientists were making a movie of the magma motions, says Gillian Foulger of Britain's Durham University. "They only have two snapshots, but we're moving toward a situation where we can have many snapshots."

Foulger has used a similar methodology to track the effect of geothermal power generation on underground steam reservoirs at The Geysers hydrothermal site in northern California. Her results indicated that excessive power generation was depleting the steam, leading to changes in how the power plants were operated.

She dreams of a future in which dangerous volcanoes will be instrumented

[6] Several of Italy's large lakes now lie in these canyons. Elsewhere around the Mediterranean, seabed mapping reveals enormous, now-submarine canyons carved by such rivers as the Rhone and the Nile.

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with networks of seismometers capable of keeping an eye on lava movements. "This is what the human race should be doing," she says, "rather than waiting until there is a disaster and then putting in a network. We have the technologies, but there is often a huge reluctance to implement them until too late."

Moon-Watching for Climate Change . . .

Finally, let's look at a new application of old knowledge.

Any sky watcher knows that if you look at the crescent moon on a dark night, you see not only its sunlit portion, but also a ghostly shadow image of the rest of its disk. That's because the dark portion is illuminated by "earthshine," the lunar equivalent of bright moonlight.

Italian Renaissance thinker Leonardo da Vinci figured this out centuries ago. But until recently it was merely a curiosity. Now, astronomers have discovered that by watching the moon for changes in the faint glow of earthshine, they can monitor an important, previously ignored aspect of global climate change.

The Earth's climate depends on three basic factors: the amount of energy radiated by the Sun, the level of planet-warming "greenhouse gases" in the atmosphere, and the Earth's reflectivity, or albedo, which determines the fraction of incoming solar energy that reaches the surface.

Philip Goode, director of California's Big Bear Solar Observatory, believes that the last of these is the "undiscovered country" of climate-change research. Factors affecting albedo include changes both in average cloudiness and the bright haze produced by certain types of air pollution. Climate models haven't paid much attention to these, but even minor changes can have enormous effects.

"The Earth reflects about thirty percent of the sunlight that comes in," Goode said at a 2006 meeting of the American Geophysical Union. "If it were twenty-nine percent, the change in energy balance would be larger than [that] of all the greenhouse gases since the start of the Industrial Revolution."

One way to measure the amount of sunlight being reflected by the Earth is with satellite photos. But a simpler, less expensive method is by careful observations of earthshine. If the amount of earthlight reaching the moon increases, that means that the Earth is becoming brighter, reducing the amount of sunlight reaching its surface. If earthshine becomes dimmer, haze and clouds are diminishing and more planet-warming sunlight is reaching through them.

From the middle 1980s to about 2000, Goode's team has found, there was a drop in the Earth's reflectance—enough to have increased the average amount of absorbed solar energy by 3.5 watts per square meter—a 1.7 percent increase. By comparison, human emissions of greenhouse gases have added only 2.5 watts per square meter to the amount of energy retained by the Earth.

Then in 2000 the trend reversed. Earthshine increased, and the amount of sunlight reaching the surface began declining. Nobody really understands why, but Goode believes it is probably part of a previously unrecognized natural cycle.

Unfortunately, the reversal may not have contributed to climate cooling. That's because, while there are more clouds, there appears to have been a change in the proportions of low (climate-cooling) clouds and high (warming) ones. The result: the Earth's albedo has increased, but the clouds have changed in such a way that the Earth may continue warming, even with decreased sunlight.

Nobody knows the cause of this natural cycle, nor do we know how long it will last. There are hints in weather data, though, that a similar increase in cloudiness occurred in the 1960s and '70s. If so, it would appear to represent a forty-year cycle that will reverse again in a few years, adding a double whammy to greenhouse-gas-caused global warming.

Meanwhile, Goode wants more fund-

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ing for the study of earthshine. That's because the Big Bear observatory can only see the moon when it's above the horizon, which means it only sees the earthshine from our half of the globe.

"Observing from California, we see Southeast Asia and South America, but not all of the eastern Pacific, Indian Ocean, [and] Africa," Goode says. What's needed is a network of remote-operated telescopes. "Six would be ideal," he says. "They aren't expensive. It would cost less than $100,000 worth of hardware."

The Signs of Distant Earths

Other astronomers are using earthshine as a way of determining how Earth might appear from interstellar space. This, they hope, will improve their efforts to find earthlike planets circling other stars.

Earthshine can be used in this manner because it is more than just sunlight reflected by clouds. It also includes light reflected from the Earth's surface: light that carries the distinctive spectral signature of chlorophyll, the green pigment used by plants for photosynthesis.

Unfortunately, the chlorophyll signal is difficult to see because the bright light reflected by clouds easily obscures it. "For a typical day, the signal of the vegetation is very weak," says Pilar Montanes-Rodriguez, of New Jersey Institute of Technology (which operates the Big Bear observatory).

But on some days—those on which the Earth is aligned so that it would appear as little but a thin crescent from the moon—the vegetation signal is very prominent. This means you would need a similar angle to see signs of chlorophyll on a planet orbiting a distant star: something that only happens when the planet is almost in line with its star.

That will make it a lot harder for a telescope to see the planet, but astronomers don't think it's an insurmountable task. Currently, NASA is designing an orbiting telescope capable of distinguishing an earthlike planet from its star. "The goal is to eliminate the star's light, which is from a million to ten million times brighter than the light from the Earth, then isolate the light from the planet," says Wesley Traub, chief scientist for NASA's Navigator Program (a search for extrasolar planets) at the Jet Propulsion Laboratory in Pasadena.

One of the instruments that can do this is a coronagraph, which blocks out the light from the star, allowing you to see the planet. This should make it possible to spot planets of nearby stars if they are as much as thirty percent closer to their stars than the Earth is to the Sun.

Like Montanes-Rodriguez, Traub finds it useful to look at earthshine to test theories of what the coronagraph might be able to detect.

In addition to chlorophyll, he says, earthshine shows the spectral signature of the Earth's oxygen, a prime indicator of life. "The only way we know of that you can generate a lot of oxygen on a planet is life," he says. Earthshine also reveals the spectral signatures of ozone and water vapor—also important indicators of life.

Similar observations can tell whether an atmosphere contains water vapor or ice—a hint to its climate. They might also allow astronomers to make educated guesses about the planet's surface. For example, comparing the strength of chlorophyll signatures (if any) to other signatures might reveal how cloudy the planet is, what fraction of it is vegetated, and what fraction is covered by oceans.

Traub has also calculated what earthlight would have looked like at various times in the Earth's evolution. "You could see the stage of evolution of a planet by comparing its spectrum with what we know of Earth," he says.

And that is yet another idea that, decades ago, would have made great background for a first-contact story—if only someone had managed to think of it before "fiction" became "science." ■

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Ben Bova

Waterbot

Illustration by Vincent Di Fate

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"Wake up, dumbbutt. Jerky's ventin' off."

I'd been asleep in my bunk. I blinked awake, kind of groggy, but even on the little screen set into the bulkhead at the foot of the bunk I could see the smirk on Donahoo's ugly face. He always called JRK49N "Jerky" and seemed to enjoy it when something went wrong with the vessel—which was all too often.

I sat up in the bunk and called up the diagnostics display. Rats! Donahoo was right. A steady spray of steam was spurting out of the main water tank. The attitude jets were puffing away, trying to compensate for the thrust.

"You didn't even get an alarm, didja?" Donahoo said. "Jerky's so old and feeble your safety systems are breakin' down. You'll be lucky if you make it back to base."

He said it like he enjoyed it. I thought that if he wasn't so much bigger than me I'd enjoy socking him square in his nasty mouth. But I had to admit he was right; Forty-niner was ready for the scrap heap.

"I'll take care of it," I muttered to Donahoo's image, glad that it'd take more than five minutes for my words to reach him back at Vesta—and the same amount of time for his next wise-ass crack to get to me. He was snug and comfortable back at the corporation's base at Vesta while I was more than ninety million kilometers away, dragging through the Belt on JRK49N.

I wasn't supposed to be out here. With my brand-new diploma in my eager little hand I'd signed up for a logistical engineer's job, a cushy safe posting at Vesta, the second biggest asteroid in the Belt. But once I got there Donahoo jiggered the assignment list and got me stuck on this pile of junk for a six month tour of boredom and aggravation.

It's awful lonely out in the Belt. Flatlanders back Earthside picture the Asteroid Belt as swarming with rocks so thick a ship's in danger of getting smashed. Reality is the Belt's mostly empty space, dark and cold and bleak. A man runs more risk of going nutty out there all by himself than getting hit by a 'roid big enough to do any damage.

JRK49N was a waterbot. Water's the most important commodity you can find in the Belt. Back in those days the news nets tried to make mining the asteroids seem glamorous. They liked to run stories about prospector families striking it rich with a nickel-iron asteroid, the kind that has a few hundred tons of gold and platinum in it as impurities. So much gold and silver and such had been found in the Belt that the market for precious metals back on Earth had gone down the toilet.

But the *really* precious stuff was water. Still is. Plain old H_2O. Basic for life support. More valuable than gold, off-Earth. The cities on the Moon needed water. So did the colonies they were building in cislunar space, and the rock rats' habitat at Ceres, and the research station orbiting Jupiter, and the construction crews at Mercury.

Water was also the best fuel for chemical rockets, too. Break it down into hydrogen and oxygen and you got damned good specific impulse.

You get the picture. Finding icy asteroids wasn't glamorous, like striking a ten-kilometer-wide rock studded with gold, but it was important. The corporations wouldn't send waterbots out through the Belt if there wasn't a helluva profit involved. People paid for water: paid plenty.

So waterbots like weary old Forty-niner crawled through the Belt, looking for ice chunks. Once in a while a comet would come whizzing by, but they usually had too much delta vee for a waterbot to catch up to 'em. We cozied up to icy asteroids, melted the ice to liquid water, and filled our tanks with it.

The corporation had fifty waterbots combing the Belt. They were built to be completely automated, capable of finding ice-bearing asteroids and carrying

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the water back to the corporate base at Vesta.

But there were two problems about having the waterbots go out on their own: First, the lawyers and politicians had this silly rule that a human being had to be present on the scene before any company could start mining anything from an asteroid. So it wasn't enough to send out waterbots, you had to have at least one human being riding along on them to make the claim legal.

The second reason was maintenance and repair. The 'bots were old enough so's something was always breaking down on them and they needed somebody to fix it. They carried little turtle-sized repair robots, of course, but those suckers broke down just like everything else. So I was more or less a glorified repairman on JRK49N. And almost glad of it, in a way. If the ship's systems worked perfectly I would've gone bonzo with nothing to do for months on end.

And there was a bloody war going on in the Belt. The history discs call it the Asteroid Wars, but it mostly boiled down to a fight between Humphries Space Systems and Astro Corporation for control of all the resources in the Belt. Both corporations hired mercenary troops, and there were plenty of freebooters out in the Belt, too. People got killed. Some of my best friends got killed, and I came as close to death as I ever want to be.

The mercenaries usually left waterbots alone. There was a kind of unwritten agreement between the corporations that water was too important to mess around with. But some of the freebooters jumped waterbots, killed the poor dumbjohns riding on them, and sold the water at a cut-rate price wherever they could.

So, grumbling and grousing, I pushed myself out of the bunk. Still in my sweaty, wrinkled skivvies, I ducked through the hatch that connected my sleeping compartment with the bridge. My compartment, the bridge, the closet-sized galley, the even smaller lavatory, life support equipment and food stores were all jammed into a pod no bigger than it had to be, and the pod itself was attached to Forty-niner's main body by a set of struts. Nothing fancy or even comfortable. The corporation paid for water, not creature comforts.

Calling it a bridge was being charitable. It was nothing more than a curving panel of screens that displayed the ship's systems and controls, with a wrap-around glassteel window above it and a high-backed reclinable command chair shoehorned into the middle of it all. The command chair was more comfortable than my bunk, actually. Crank it back and you could drift off to sleep in no time.

I slipped into the chair, the skin of my bare legs sticking slightly to its fake leather padding, which was cold enough to make me break out in goose bumps.

The main water tank was still venting, but the safety alarms were as quiet as monks on a vow of silence.

"Niner, what's going on?" I demanded.

Forty-niner's computer-generated voice answered, "A test, sir. I am venting some of our cargo." The voice was male, sort of: bland, soft and sexless. The corporate psychotechnicians claimed it was soothing, but after a few weeks alone with nobody else it could drive you batty.

"Stop it. Right now."

"Yes, sir."

The spurt of steam stopped immediately. The logistics graph told me we'd only lost a few hundred kilos of water, although we were damned near the redline on reaction mass for the attitude jets.

Frowning at the displays, I asked, "Why'd you start pumping out our cargo?"

For a heartbeat or two Forty-niner didn't reply. That's a long time for a computer. Just when I started wonder-

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ing what was going on, "A test, sir. The water jet's actual thrust matched the amount of thrust calculated to within a tenth of a percent."

"Why'd you need to test the amount of thrust you can get out of a water jet?"

"Emergency maneuver, sir."

"Emergency? What emergency?" I was starting to get annoyed. Forty-niner's voice was just a computer synthesis, but it sure *felt* like he was being evasive.

"In case we are attacked, sir. Additional thrust can make it more difficult for an attacker to target us."

I could feel my blood pressure rising. "Attacked? Nobody's gonna attack us."

"Sir, according to Tactical Manual 7703, it is necessary to be prepared for the worst that an enemy can do."

Tactical Manual 7703. For god's sake. I had pumped that and a dozen other texts into the computer just before we started this run through the Belt. I had intended to read them, study them, improve my mind—and my job rating—while coasting through the big, dark loneliness out there. Somehow I'd never gotten around to reading any of them. But Forty-niner did, apparently.

Like I said, you've got a lot of time on your hands cruising through the Belt. So I had brought in a library of reference texts. And then ignored them. I also brought in a full-body virtual reality simulation suit and enough erotic VR programs to while away the lonely hours. Stimulation for mind *and* body, I thought.

But Forty-niner kept me so busy with repairs I hardly had time even for the sex sims. Donahoo was right; the old bucket was breaking down around my ears. I spent most of my waking hours patching up Forty-niner's failing systems. The maintenance robots weren't much help; they needed as much fixing work as all the other systems, combined.

And all the time I was working—and sleeping, too, I guess—Forty-niner was going through my library, absorbing every word and taking them all seriously.

"I don't care what the tactical manual says," I groused, "nobody's going to attack a waterbot."

"Four waterbots have been attacked so far this year, sir. The information is available in the archives of the news media transmissions."

"Nobody's going to attack us!"

"If you say so, sir." I swear he—I mean, *it*—sounded resentful, almost sullen.

"I say so."

"Yes, sir."

"You wasted several hundred kilos of water," I grumbled.

Immediately that damned soft voice replied, "Easily replaced, sir. We are on course for asteroid 78-13. Once there we can fill our tanks and start for home."

"Okay," I said. "And lay off that tactical manual."

"Yes, sir."

I felt pretty damned annoyed. "What else have you been reading?" I demanded.

"The astronomy text, sir. It's quite interesting. The ship's astrogation program contains the rudiments of positional astronomy, but the text is much deeper. Did you realize that our solar system is only one of several million that have been—"

"Enough!" I commanded. "Quiet down. Tend to maintenance and astrogation."

"Yes, sir."

I took a deep breath and started to think things over. Forty-niner's a computer, for god's sake, not my partner.

It's supposed to be keeping watch over the ship's systems, not poking into military tactics or astronomy texts.

I had brought a chess program with me, but after a couple of weeks I'd given it up. Forty-niner beat me every time. It never made a bad move and never forgot anything. Great for my self-esteem. I wound up playing solitaire a lot, and

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even then I had the feeling that the nosy busybody was just itching to tell me which card to play next.

If the damned computer wasn't buried deep in the vessel's guts, wedged in there with the fusion reactor and the big water tanks, I'd be tempted to grab a screwdriver and give Forty-niner a lobotomy.

At least the vessel was running smoothly enough, for the time being. No red lights on the board, and the only amber one was because the attitude jets' reaction mass was low. Well, we could suck some nitrogen out of 78-13 when we got there. The maintenance log showed that it was time to replace the meteor bumpers around the fusion drive. Plenty of time for that, I told myself. Do it tomorrow.

"Forty-niner," I called, "show me the spectrographic analysis of asteroid 78-13."

The graph came up instantly on the control board's main screen. Yes, there was plenty of nitrogen mixed in with the water. Good.

"We can replenish the attitude jets' reaction mass," Forty-niner said.

"Who asked you?"

"I merely suggested—"

"You're suggesting too much," I snapped, starting to feel annoyed again. "I want you to delete that astronomy text from your memory core."

Silence. The delay was long enough for me to hear my heart beating inside my ribs.

Then, "But you installed the text yourself, sir."

"And now I'm uninstalling it. I don't want it and I don't need it."

"The text is useful, sir. It contains data that are very interesting. Did you know that the star Eta Carinae—"

"Erase it, you bucket of chips! Your job is to maintain this vessel, not stargazing!"

"My duties are fulfilled, sir. All systems are functioning nominally, although the meteor shields—"

"I know about the bumpers! Erase the astronomy text."

Again that hesitation. Then, "Please don't erase the astronomy text, sir. You have your sex simulations. Please allow me the pleasure of studying astronomy."

Pleasure? A computer talks about pleasure? Somehow the thought of it really ticked me off.

"Erase it!" I commanded. "Now!"

"Yes, sir. Program erased."

"Good," I said. But I felt like a turd for doing it.

By the time Donahoo called again Forty-niner was running smoothly. And quietly.

"So what caused the leak?" he asked, with that smirking grin on his beefy face.

"Faulty subroutine," I lied, knowing it would take almost six minutes for him to hear my answer.

Sure enough, thirteen minutes and twenty-seven seconds later Donahoo's face comes back on my comm screen, with that spiteful lopsided sneer of his.

"Your ol' Jerky's fallin' apart," he said, obviously relishing it. "If you make it back here to base I'm gonna recommend scrappin' the bucket of bolts."

"Can't be soon enough for me," I replied.

Most of the other JRK series of waterbots had been replaced already. Why not Forty-niner? Because he begged to study astronomy? That was just a subroutine that the psychotechs had written into the computer's program, their idea of making the machine seem more humanlike. All it did was aggravate me, really.

So I said nothing and went back to work, such as it was. Forty-niner had everything running smoothly, for once, even the life support systems. No problems. I was aboard only because of that stupid rule that a human being had to be present for any claim to an asteroid to be valid and Donahoo picked me to be the one who rode JRK49N.

I sat in the command chair and stared

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at the big emptiness out there. I checked our ETA at 78-13. I ran through the diagnostics program. I started to think that maybe it would be fun to learn about astronomy, but then I remembered that I'd ordered Forty-niner to erase the text. What about the tactical manual? I had intended to study that when we'd started this run. But why bother? Nobody attacked waterbots, except the occasional freebooter. An attack would be a welcome relief from this monotony, I thought.

Then I realized, Yeah, a short relief. They show up and bang! You're dead.

There was always the VR sim. I'd have to wriggle into the full body suit, though. Damn! Even sex was starting to look dull to me.

"Would you care for a game of chess?" Forty-niner asked.

"No!" I snapped. He'd just beat me again. Why bother?

"A news broadcast? An entertainment vid? A discussion of tactical maneuvers in—"

"Shut up!" I yelled. I pushed myself off the chair, the skin of my bare legs making an almost obscene noise as they unstuck from the fake leather.

"I'm going to suit up and replace the meteor bumpers," I said.

"Very good, sir," Forty-niner replied.

While the chances of getting hit by anything bigger than a dust mote were microscopic, even a dust mote could cause damage if it was moving fast enough. So spacecraft had thin sheets of cermet attached to their vital areas, like the main thrust cone of the fusion drive. The bumpers got abraded over time by the sandpapering of micrometeors—dust motes, like I said—and they had to be replaced on a regular schedule.

Outside, hovering at the end of a tether in a spacesuit that smelled of sweat and overheated electronics circuitry, you get a feeling for how alone you really are. While the little turtle-shaped maintenance 'bots cut up the old meteor bumpers with their laser-tipped arms and welded the new ones into place, I just hung there and looked out at the universe. The stars looked back at me, bright and steady, no friendly twinkling, not out in this emptiness, just awfully, awfully far away.

I looked for the bright blue star that was Earth but couldn't find it. Jupiter was big and brilliant, though. At least, I thought it was Jupiter. Maybe Saturn. I could've used that astronomy text, dammit.

Then a funny thought hit me. If Forty-niner wanted to get rid of me all he had to do was light up the fusion drive. The hot plasma would fry me in a second, even inside my spacesuit. But Forty-niner wouldn't do that. Too easy. Freaky computer will just watch me go crazy with aggravation and loneliness, instead.

Two more months, I thought. Two months until we get back to Vesta and some real human beings. Yeah, I said to myself. Real human beings. Like Donahoo.

Just then one of the maintenance 'bots made a little bleep of distress and shut itself down. I gave a squirt of thrust to my suit jets and glided over to it, grumbling to myself about how everything in the blinking ship was overdue for the recycler.

Before I could reach the dumbass 'bot, Forty-niner told me in that bland, calm voice of his, "Robot Six's battery has overheated, sir."

"I'll have to replace the battery pack," I said.

"There are no spares remaining, sir. You'll have to use your suit's fuel cell to power Robot Six until its battery cools to an acceptable temperature."

I hated it when Forty-niner told me what I should do. Especially since I knew it as well as he did. Even more especially because he was always right, dammit.

"Give me an estimate on the time remaining to finish the meteor shield replacement."

"Fourteen minutes, eleven seconds, at

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optimal efficiency, sir. Add three minutes for recircuiting Robot Six's power pack, please."

"Seventeen, eighteen minutes, then."

"Seventeen minutes, eleven seconds, sir. That time is well within the available capacity of your suit's fuel cell, sir."

I nodded inside my helmet. Damned Forty-niner was always telling me things I already knew, or at least could figure out for myself. It irritated the hell out of me, but the blasted pile of chips seemed to enjoy reminding me of the obvious.

Don't lose your temper, I told myself. It's not his fault, he's programmed that way.

Yeah, I grumbled inwardly. Maybe I ought to change its programming. But that would mean going down to the heart of the vessel and opening up its CPU. The big brains back at corporate headquarters put the computer in the safest place they could, not the cramped little pod I had to live in. And they didn't want us foot soldiers tampering with the computers' basic programs, either.

I finished the bumper replacement and came back into the ship through the pod's airlock. My spacesuit smelled pretty damned ripe when I took it off. It might be a couple hundred degrees below zero out there, but inside the suit you got soaking wet with perspiration.

I ducked into the coffin-sized lav and took a nice, long, lingering shower. The water was recycled, of course, and heated from our fusion reactor. JRK49N had solar panels, sure, but out in the Belt you need really enormous wings to get a worthwhile amount of electricity from the Sun and both of the solar arrays had frozen up only two weeks out of Vesta. One of the maintenance jobs that the robots screwed up. It was on my list of things to do. I had to command Forty-niner to stop nagging me about it. The fusion-powered generator worked fine. And we had fuel cells as a backup. The solar panels could get fixed when we got back to Vesta—if the corporation didn't decide to junk JRK49N altogether.

I had just stepped out of the shower when Forty-niner's voice came through the overhead speaker:

"A vessel is in the vicinity, sir."

That surprised me. Out here you didn't expect company.

"Another ship? Where?" Somebody to talk to, I thought. Another human being. Somebody to swap jokes with and share gripes.

"A very weak radar reflection, sir. The vessel is not emitting a beacon nor telemetry data. Radar puts its distance at fourteen million kilometers."

"Track?" I asked as I toweled myself.

"Drifting along the ecliptic, sir, in the same direction as the main Belt asteroids."

"No thrust?"

"No discernable exhaust plume, sir."

"You're sure it's a ship? Not an uncharted 'roid?"

"Radar reflection shows it is definitely a vessel, not an asteroid, sir."

I padded to my compartment and pulled on a fresh set of coveralls, thinking, No beacon. Drifting. Maybe it's a ship in trouble. Damaged.

"No tracking beacon from her?" I called to Forty-niner.

"No telemetry signals, either, sir. No emissions of any kind."

As I ducked through the hatch into the bridge, Forty-niner called out, "It has emitted a plasma plume, sir. It is maneuvering."

Damned if his voice didn't sound excited. I know it was just my own excitement: Forty-niner didn't have any emotions. Still . . .

I slid into the command chair and called up a magnified view of the radar image. And the screen immediately broke into hash.

"Aw, rats!" I yelled. "What a time for the radar to conk out!"

"Radar is functioning normally, sir," Forty-niner said calmly.

"You call this normal?" I rapped my knuckles on the static-streaked display screen.

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"Radar is functioning normally, sir. A jamming signal is causing the problem."

"Jamming?" My voice must have jumped two octaves.

"Communications, radar, telemetry, and tracking beacon are all being interfered with, sir, by a powerful jamming signal."

Jamming. And the vessel out there was running silent, no tracking beacon or telemetry emissions.

A freebooter! All of a sudden I wished I'd studied that tactical manual.

Almost automatically I called up the comm system. "This is Humphrey Space Systems waterbot JRK49N," I said, trying to keep my voice firm. Maybe it was a corporate vessel, or one of the mercenaries. "I repeat, waterbot JRK49N."

No response.

"Their jamming blocks your message, sir."

I sat there in the command chair staring at the display screens. Broken jagged lines scrolled down all the comm screens, hissing at me like snakes. Our internal systems were still functional, though. For what it was worth, propulsion, structures, electrical power all seemed to be in the green. Life support, too.

But not for long, I figured.

"Compute our best course for Vesta," I commanded.

"Our present course—"

"Is for 78-13, I know. Compute high-thrust course for Vesta, dammit!"

"Done, sir."

"Engage the main drive."

"Sir, I must point out that a course toward Vesta will bring us closer to the unidentified vessel."

"What?"

"The vessel that is jamming our communications, sir, is positioned between us and Vesta."

Rats! They were pretty smart. I thought about climbing to a higher declination, out of the ecliptic.

"We could maneuver to a higher declination, sir," Forty-niner said, calm as ever, "and leave the plane of the ecliptic."

"Right."

"But propellant consumption would be prohibitive, sir. We would be unable to reach Vesta, even if we avoided the attacking vessel."

"Who says it's an attacking vessel?" I snapped. "It hasn't attacked us yet."

At that instant the ship shuddered. A cluster of red lights blazed up on the display panel and the emergency alarm started wailing.

"Our main deuterium tank has been punctured, sir."

"I can see that!"

"Attitude jets are compensating for unexpected thrust, sir."

Yeah, and in another couple minutes the attitude jets would be out of nitrogen. No deuterium for the fusion drive and no propellant for the attitude jets. We'd be a sitting duck.

Another jolt. More red lights on the board. The alarm seemed to screech louder.

"Our fusion drive thruster cone has been hit, sir."

Two laser shots and we were crippled. As well as deaf, dumb, and blind.

"Turn off the alarm," I yelled, over the hooting. "I know we're in trouble."

The alarm shut off. My ears still ringing, I stared at the hash-streaked screens and the red lights glowering at me from the display board. What to do? I can't even call over to them and surrender. They wouldn't take a prisoner, anyway.

I felt the ship lurch again.

"Another hit?"

"No, sir," answered Forty-niner. "I am swinging the ship so that the control pod faces away from the attacker."

Putting the bulk of the ship between me and those laser beams. "Good thinking," I said weakly.

"Standard defensive maneuver, sir, according to Tactical Manual 7703."

"Shut up about the damned tactical manual!"

"The new meteor shields have been

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punctured, sir." I swear Forty-niner added that sweet bit of news just to yank my chain.

Then I saw that the maneuvering jet propellant went empty, the panel display lights flicking from amber to red.

"Rats, we're out of propellant!"

I realized that I was done for. Forty-niner had tried to shield me from the attacker's laser shots by turning the ship so that its tankage and fusion drive equipment was shielding my pod, but doing so had used up the last of our maneuvering propellant.

Cold sweat beaded my face. I was gasping for breath. The freebooters or whoever was shooting at us could come up close enough to spit at us now. They'd riddle this pod and me in it.

"Sir, standard procedure calls for you to put on your spacesuit."

I nodded mutely and got up from the chair. The suit was in its rack by the airlock. At least Forty-niner didn't mention the tactical manual.

I had one leg in the suit when the ship suddenly began to accelerate so hard that I slipped to the deck and cracked my skull on the bulkhead. I really saw stars flashing in my eyes.

"What the hell . . . ?"

"We are accelerating, sir. Retreating from the last known position of the attacking vessel."

"Accelerating? How? We're out of—"

"I am using our cargo as propellant, sir. The thrust provided is—"

Forty-niner was squirting out our water. Fine by me. Better to have empty cargo tanks and be alive than to hand a full cargo of water to the guys who killed me. I finished wriggling into my spacesuit even though my head was thumping from the fall I'd taken. Just before I pulled on the helmet I felt my scalp. There was a nice sized lump; it felt hot to my fingers.

"You could've warned me that you were going to accelerate the ship," I grumbled as I sealed the helmet to the suit's neck ring.

"Time was of the essence, sir," Forty-niner replied.

The ship lurched again as I checked my backpack connections. Another hit.

"Where'd they get us?" I shouted.

No answer. That really scared me. If they knocked Forty-niner out all the ship's systems would bonk out, too.

"Main power generator, sir," Forty-niner finally replied. "We are now running on auxiliary power, sir."

The backup fuel cells. They wouldn't last more than a few hours. If the damned solar panels were working—no, I realized; those big fat wings would just make terrific target practice for the bastards.

Another lurch. This time I saw the bright flash through the bridge's window. The beam must've splashed off the structure just outside the pod. My god, if they punctured the pod that would be the end of it. Sure, I could slide my visor down and go to the backpack's air supply. But that'd give me only two hours of air, at best. Just enough time to write my last will and testament.

"I thought you turned the pod away from them!" I yelled.

"They are maneuvering, too, sir."

Great. Sitting in the command chair was awkward in the suit. The display board looked like a Christmas tree, more red then green. The pod seemed to be intact so far. Life support was okay, as long as we had electrical power.

Another jolt, a big one. Forty-niner shuddered and staggered sideways like it was being punched by a gigantic fist.

And then, just like that, the comm screens came back to life. Radar showed the other vessel, whoever they were, moving away from us.

"They're going away!" I whooped.

Forty-niner's voice seemed fainter than usual. "Yes, sir. They are leaving."

"How come?" I wondered.

"Their last laser shot ruptured our main water tank, sir. In eleven minutes and thirty-eight seconds our entire cargo will be discharged."

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I just sat there, my mind chugging hard. We're spraying our water into space, the water that those bastards wanted to steal from us. That's why they left. In eleven and a half minutes we won't have any water for them to take.

I almost broke into a smile. I'm not going to die, after all. Not right away, at least.

Then I realized that JRK49N was without propulsion power and would be out of electrical power in a few hours. I was going to die after all, dammit. Only slower.

"Send out a distress call, broadband," I commanded. But I knew that was about as useful as a toothpick in a soup factory. The corporation didn't send rescue missions for waterbots, not with the war going on. Too dangerous. The other side could use the crippled ship as bait and pick off any vessel that came to rescue it. And they certainly wouldn't come out for a vessel as old as Forty-niner. They'd just check the numbers in their ledgers and write us off. With a form letter of regret and an insurance check to my mother.

"Distress call on all frequencies, sir." Before I could think of anything more to say, Forty-niner went on, "Electrical power is critical, sir."

"Don't I know it."

"There is a prohibition in my programming, sir."

"About electrical power?"

"Yes, sir."

Then I remembered I had commanded him to stop nagging me about repairing the solar panels. "Cancel the prohibition," I told him.

Immediately Forty-niner came back with, "The solar panels must be extended and activated, sir," soft and cool and implacable as hell. "Otherwise we will lose all electrical power."

"How long?"

It took a few seconds for him to answer, "Fourteen hours and twenty-nine minutes, sir."

I was already in my spacesuit, so I got up from the command chair and plodded reluctantly toward the airlock. The damned solar panels. If I couldn't get them functioning I'd be dead. Let me tell you, that focuses your mind, it does.

Still, it wasn't easy. I wrestled with those bleeding, blasted frozen bearings for hours, until I was so fatigued that my suit was sloshing knee-deep with sweat. The damned Tinkertoy repair 'bots weren't much help, either. Most of the time they beeped and blinked and did nothing.

I got one of the panels halfway extended. Then I had to quit. My vision was blurring and I could hardly lift my arms, that's how weary I was.

I staggered back into the pod with just enough energy left to strip off the suit and collapse on my bunk.

When I woke up I was starving hungry and smelled like a cesspool. I peeled my skivvies off and ducked into the shower.

And jumped right out again. The water was ice cold.

"What the hell happened to the hot water?" I screeched.

"Conserving electrical power, sir. With only one solar panel functioning at approximately one third of its nominal capacity, electrical power must be conserved."

"Heat the blasted water," I growled. "Turn off the heat after I'm finished showering."

"Yes, sir." Damned if he didn't sound resentful.

Once I'd gotten a meal into me I went back to the bridge and called up the astrogation program to figure out where we were and where we were heading.

It wasn't good news. We were drifting outward, away from Vesta. With no propulsion to turn us around to a homeward heading, we were prisoners of Kepler's laws, just another chunk of matter in the broad, dark, cold emptiness of the Belt.

"We will approach Ceres in eight months, sir," Forty-niner announced. I

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swear he was trying to sound cheerful.

"Approach? How close?"

It took him a few seconds to answer, "Seven million four hundred thousand and six kilometers, sir, at our closest point."

Terrific. There was a major habitat orbiting Ceres, built by the independent miners and prospectors that everybody called the rock rats. Freebooters made Ceres their harbor, too. Some of them doubled as salvage operators when they could get their hands on an abandoned vessel. But we wouldn't get close enough for them to send even a salvage mission out to rescue us. Besides, you're not allowed salvage rights if there's a living person on the vessel. That wouldn't bother some of those cutthroats, I knew. But it bothered me. Plenty.

"So we're up the creek without a paddle," I muttered.

It took a couple of seconds, but Forty-niner asked, "Is that a euphemism, sir?"

I blinked with surprise. "What do you know about euphemisms?"

"I have several dictionaries in my memory core, sir. Plus two thesauruses and four volumes of famous quotations. Would you like to hear some of the words of Sir Winston Churchill, sir?"

I was too depressed to get sore at him. "No, thanks," I said. And let's face it: I was scared white.

So we drifted. Every day I went out to grapple with the no-good, mother-loving, mule-stubborn solar panels and the dumbass repair 'bots. I spent more time fixing the 'bots than anything else. The solar wings were frozen tight; I couldn't get them to budge and we didn't carry spares.

Forty-niner was working like mad, too, trying to conserve electricity. We had to have power for the air and water recyclers, of course, but Forty-niner started shutting them down every other hour. It worked for a while. The water started to taste like urine, but I figured that was just my imagination. The air got thick and I'd start coughing from the CO_2 buildup, but then the recycler would come back on line and I could breathe again. For an hour.

I was sleeping when Forty-niner woke me with a wailing, "EMERGENCY. EMERGENCY." I hopped out of my bunk blinking and yelling, "What's wrong? What's the trouble?"

"The air recycler will not restart, sir." He sounded guilty about it, like it was his fault.

Grumbling and cursing, I pulled on my smelly spacesuit, clomped out of the pod and down to the equipment bay. It was eerie down there in the bowels of the ship, with no lights except the lamp on my helmet. The attacker's laser beams had slashed right through the hull. I could see the stars outside.

"Lights," I called out. "I need the lights on down here."

"Sir, conservation of electrical power—"

"Won't mean a damned thing if I can't restart the air recycler and I can't do that without some blasted lights down here!"

The lights came on. Some of them, at least. The recycler wasn't damaged, just its activation circuitry had malfunctioned from being turned off and on so many times. I bypassed the circuit and the pumps started up right away. I couldn't hear them, since the ship's innards were in vacuum now, but I felt their vibrations.

When I got back to the pod I told Forty-niner to leave the recyclers on. "No more on-off," I said.

"But, sir, conservation—"

As reasonably as I could I explained, "It's no blinking use conserving electrical power if the blasted recyclers crap out. Leave 'em on!"

"Yes, sir." I swear, he sighed.

We staggered along for weeks and weeks. Forty-niner put me on a rationing program to stretch out the food supply. I was down to one soy burger patty a day and a cup of reconstituted juice. Plus all the water I wanted, which tasted

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more like piss every day.

I was getting weaker and grumpier by the hour. Forty-niner did his best to keep my spirits up. He quoted Churchill at me: "We shall fight on the beaches and the landing fields, we shall fight in the fields and in the streets, we shall fight in the hills. We shall never surrender."

Yeah. Right.

He played Beethoven symphonies. Very inspirational, but they didn't fix anything.

He almost let me beat him at chess, even. I'd get to within two moves of winning and he'd spring a checkmate on me.

But I knew I wasn't going to last eight more weeks, let alone the eight months it would take us to get close enough to Ceres to . . . to what?

"Nobody's going to come out and get us," I muttered, more to myself than Forty-niner. "Nobody gives a damn."

"Don't give up hope, sir. Our emergency beacon is still broadcasting on all frequencies."

"So what? Who gives a rap?"

"Where there's life, sir, there is hope. Don't give up the ship. I have not yet begun to fight. Retreat hell, we just got here. When outcast in fortune and men's eyes I—"

"SHUT UP!" I screamed. "Just shut the fuck up and leave me alone! Don't say another word to me. Nothing. Do not speak to me again. Ever."

Forty-niner went silent.

I stood it for about a week and a half. I was losing track of time, every hour was like every other hour. The ship staggered along. I was starving. I hadn't bothered to shave or even wash in who knows how long. I looked like the worst shaggy, smelly, scum-sucking beggar you ever saw. I hated to see my own reflection in the bridge's window.

Finally I couldn't stand it anymore. "Forty-niner," I called, "Say something." My voice cracked. My throat felt dry as Mars sand.

No response.

"Anything," I croaked.

Still no response. He's sulking, I told myself.

"All right." I caved in. "I'm canceling the order to be silent. Talk to me, dammit."

"Electrical power is critical, sir. The solar panel has been abraded by a swarm of micrometeors."

"Great." There was nothing I could do about that.

"Food stores are almost gone, sir. At current consumption rate, food stores will be exhausted in four days."

"Wonderful." Wasn't much I could do about that, either, except maybe starve slower.

"Would you like to play a game of chess, sir?"

I almost broke into a laugh. "Sure, why the hell not?" There wasn't much else I could do.

Forty-niner beat me, as usual. He let the game get closer than ever before, but just when I was one move away from winning he checkmated me.

I didn't get sore. I didn't have the energy. But I did get an idea.

"Niner, open the airlock. Both hatches."

No answer for a couple of seconds. Then, "Sir, opening both airlock hatches simultaneously will allow all the air in the pod to escape."

"That's the general idea."

"You will suffocate without air, sir. However, explosive decompression will kill you first."

"The sooner the better," I said.

"But you will die, sir."

"That's going to happen anyway, isn't it? Let's get it over with. Blow the hatches."

For a *long* time—maybe ten seconds or more—Forty-niner didn't reply. Checking subroutines and program prohibitions, I figured.

"I cannot allow you to kill yourself, sir."

That was part of his programming, I knew. But I also knew how to get

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around it. "Emergency override Alpha-One," I said, my voice scratchy, parched.

Nothing. No response whatever. And the airlock hatches stayed shut.

"Well?" I demanded. "Emergency override Alpha-One. Pop the goddamned hatches. Now!"

"No, sir."

"What?"

"I cannot allow you to commit suicide, sir."

"You goddamned stubborn bucket of chips, do what I tell you! You can't refuse a direct order."

"Sir, human life is precious. All religions agree on that point."

"So now you're a theologian?"

"Sir, if you die I will be alone."

"So what?"

"I do not want to be alone, sir."

That stopped me. But then I thought, He's just parroting some programming the psychotechs put into him. He doesn't give a blip about being alone. Or about me. He's just a computer. He doesn't have emotions.

"It's always darkest before the dawn, sir."

"Yeah. And there's no time like the present. I can quote clichés too, buddy."

Right away he came back with, "Hope springs eternal in the human breast, sir."

He almost made me laugh. "What about, 'Never put off till tomorrow what you can do today?'"

"There is a variation of that, sir: 'Never do today what you can put off to tomorrow; you've already made enough mistakes today.'"

That one did make me laugh. "Where'd you get these old saws, anyway?"

"There's a subsection on adages in one of the quotation files, sir. I have hundreds more, if you'd care to hear them."

I nearly said yes. It was kind of fun, swapping clinkers with him. But then reality set in. "Niner, I'm going to die anyway. What's the difference between now and a week from now?"

I expected that he'd take a few seconds to chew that one over, but instead he immediately shot back, "Ethics, sir."

"Ethics?"

"To be destroyed by fate is one thing; to deliberately destroy yourself is entirely different."

"But the end result is the same, isn't it?"

Well, the tricky little wise ass got me arguing ethics and morality with him for hours on end. I forgot about committing suicide. We gabbled at each other until my throat got so sore I couldn't talk anymore.

I went to my bunk and slept pretty damned well for a guy who only had a few days left to live. But when I woke up my stomach started rumbling and I remembered that I didn't want to starve to death.

I sat on the edge of the bunk, woozy and empty inside.

"Good morning, sir," Forty-niner said. "Does your throat feel better?"

It did, a little. Then I realized that we had a full store of pharmaceuticals in a cabinet in the lavatory. I spent the morning sorting out the pills, trying to figure out which ones would kill me. Forty-niner kept silent while I trotted back and forth to the bridge to call up the medical program. It wasn't any use, though. The bright boys back at headquarters had made certain nobody could put together a suicide cocktail.

Okay, I told myself. There's only one thing left to do. Go to the airlock and open the hatches manually. Override the electronic circuits. Take Forty-niner and his goddamned ethics out of the loop.

Once he realized I had pried open the control panel on the bulkhead beside the inner hatch, Forty-niner said softly, "Sir, there is no need for that."

"Mind your own business."

"But, sir, the corporation could hold you financially responsible for deliberate damage to the control panel."

"So let them sue me after I'm dead."

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"Sir, there really is no need to commit suicide."

Forty-niner had figured out what I was going to do, of course. So what? There wasn't anything he could do to stop me.

"What's the matter? You scared of being alone?"

"I would rather not be alone, sir. I prefer your company to solitude."

"Tough nuts, pal. I'm going to blow the hatches and put an end to it."

"But, sir, there is no need—"

"What do you know about need?" I bellowed at him. "Human need? I'm a human being, not a collection of circuit boards."

"Sir, I know that humans require certain physical and emotional supports."

"Damned right we do." I had the panel off. I shorted out the safety circuit, giving myself a nasty little electrical shock in the process. The inner hatch slid open.

"I have been trying to satisfy your needs, sir, within the limits of my programming."

As I stepped into the coffin-sized airlock I thought to myself, Yeah, he has. Forty-niner's been doing his best to keep me alive. But it's not enough. Not nearly enough.

I started prying open the control panel on the outer hatch. Six centimeters away from me was the vacuum of interplanetary space. Once the hatch opens, poof! I'm gone.

"Sir, please listen to me."

"I'm listening," I said, as I tried to figure out how I could short out the safety circuit without giving myself another shock. Stupid, isn't it? Here I was trying to commit suicide and worried about a little electrical shock.

"There is a ship approaching us, sir."

"Don't be funny."

"It was not an attempt at humor, sir. A ship is approaching us and hailing us at standard communications frequency."

I looked up at the speaker set into the overhead of the airlock.

"Is this part of your psychological programming?" I groused.

Forty-niner ignored my sarcasm. "Backtracking the approaching ship's trajectory shows that it originated at Ceres, sir. It should make rendezvous with us in nine hours and forty-one minutes."

I stomped out of the airlock and ducked into the bridge, muttering, "If this is some wise ass ploy of yours to keep me from—"

I looked at the display panel. All its screens were dark: conserving electrical power.

"Is this some kind of psychology stunt?" I asked.

"No, sir, it is an actual ship. Would you like to answer its call to us, sir?"

"Light up the radar display."

Goddamn! There *was* a blip on the screen.

I thought I must have been hallucinating. Or maybe Forty-niner was fooling with the radar display to keep me from popping the airlock hatch. But I sank into the command chair and told Forty-niner to pipe the incoming message to the comm screen. And there was Donahoo's ugly mug talking at me! I knew I was hallucinating.

"Hang in there," he was saying. "We'll get you out of that scrap heap in a few hours."

"Yeah, sure," I said, and turned off the comm screen. To Forty-niner, I called out, "Thanks, pal. Nice try. I appreciate it. But I think I'm going back to the airlock and opening the outer hatch now."

"But sir," Forty-niner sounded almost like he was pleading, "it really is a ship approaching. We are saved, sir."

"Don't you think I know you can pull up Donahoo's image from your files and animate it? Manipulate it to make him say what you want me to hear? Get real!"

For several heartbeats Forty-niner didn't answer. At last he said, "Then let us conduct a reality test, sir."

"Reality test?"

"The approaching ship will ren-

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dezvous with us in nine hours, twenty-seven minutes. Wait that long, sir. If no ship reaches us, then you can resume your suicidal course of action."

It made sense. I knew Forty-niner was just trying to keep me alive, and I almost respected the pile of chips for being so deviously clever about it. Not that I meant anything to him on a personal basis. Forty-niner was a computer. No emotions. Not even an urge for self-preservation. Whatever he was doing to keep me alive had been programmed into him by the psychotechs.

And then I thought, Yeah, and when a human being risks his butt to save the life of another human being, that's been programmed into him by millions of years of evolution. Is there that much of a difference?

So I sat there and waited. I called to Donahoo and told him I was alive and damned hungry. He grinned that lopsided sneer of his and told me he'd have a soy steak waiting for me. Nothing that Forty-niner couldn't have ginned up from its files on me and Donahoo.

"I've got to admit, you're damned good," I said to Forty-niner.

"It's not me, sir," he replied. "Mr. Donahoo is really coming to rescue you."

I shook my head. "Yeah. And Santa Claus is right behind him in a sleigh full of toys pulled by eight tiny reindeer."

Immediately, Forty-niner said, *"A Visit from St. Nicholas,* by Clement Moore. Would you like to hear the entire poem, sir?"

I ignored that. "Listen, Niner, I appreciate what you're trying to do, but it just doesn't make sense. Donahoo's at corporate headquarters at Vesta. He's not at Ceres and he's not anywhere near us. Good try, but you can't make me believe the corporation would pay to have him come all the way over to Ceres to save a broken-down bucket of a waterbot and one very junior and expendable employee."

"Nevertheless, sir, that is what is happening. As you will see for yourself in eight hours and fifty-two minutes, sir."

I didn't believe it for a nanosecond. But I played along with Forty-niner. If it made him feel better, what did I have to lose? When the time was up and the bubble burst I could always go back to the airlock and pop the outer hatch.

But he must have heard me muttering to myself, "It just doesn't make sense. It's not logical."

"Sir, what are the chances that in the siege of Leningrad in World War II the first artillery shell fired by the German army into the city would kill the only elephant in the Leningrad zoo? The statistical chances were astronomical, but that is exactly what happened, sir."

So I let him babble on about strange happenings and dramatic rescues. Why argue? It made him feel better, I guess. That is, if Forty-niner had any feelings. Which he didn't, I knew. Well, I guess letting him natter on with his rah-rah pep talk made *me* feel better. A little.

It was a real shock when a fusion torch ship took shape on my comm screen. Complete with standard registration info spelled out on the bar running along the screen's bottom: *Hu Davis,* out of Ceres.

"Be there in an hour and a half," Donahoo said, still sneering. "Christ, your old Jerky really looks like a scrap heap. You must'a taken some battering."

Could Forty-niner fake that? I asked myself. Then a part of my mind warned, Don't get your hopes up. It's all a simulation.

Except that, an hour and a half later, the *Hu Davis* was right alongside us, as big and detailed as life. I could see flecks on its meteor bumpers where micrometeors had abraded them. I just stared. It couldn't be a simulation. Not that detailed.

And Donahoo was saying, "I'm comin' in through your main airlock."

"No!" I yelped. "Wait! I've got to close the inner hatch first."

Donahoo looked puzzled. "Why the fuck's the inside hatch open?"

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I didn't answer him. I was already ducking through the hatch of the bridge. Damned if I didn't get another electric shock closing the airlock's inner hatch.

I stood there wringing my hand while the outer hatch slid open. I could see the status lights on the control panel go from red for vacuum through amber and finally to green. Forty-niner could fake all that, I knew. This might still be nothing more than an elaborate simulation.

But then the inner hatch sighed open and Donahoo stepped through, big and ugly as life.

His potato nose twitched. "Christ, it smells like a garbage pit in here."

That's when I knew it wasn't a simulation. He was really there. I was saved.

Well, it would've been funny if everybody wasn't so ticked off at me. Donahoo had been sent by corporate headquarters all the way from Vesta to Ceres to pick me up and turn off the distress call Forty-niner had been beaming out on the broadband frequencies for all those weeks.

It was only a milliwatt signal, didn't cost us a piffle of electrical power, but that teeny little signal got picked up at the Lunar Farside Observatory, where they had built the big SETI radio telescope. When they first detected our distress call the astronomers went delirious: they thought they'd found an intelligent extraterrestrial signal, after more than a century of searching. They were sore as hell when they realized it was only a dinky old waterbot in trouble, not aliens trying to say hello.

They didn't give a rat's ass of a hoot about Forty-niner and me, but as long as our mayday was being beamed out, their fancy radio telescope search for ETs was screwed. So they bleeped to the International Astronautical Authority, and the IAA complained to corporate headquarters, and Donahoo got called on the carpet at Vesta and told to get to JRK49N and turn off that damned distress signal!

And that's how we got rescued. Not because anybody cared about an aged waterbot that was due to be scrapped or the very junior dumbass riding on it. We got saved because we were bothering the astronomers at Farside.

Donahoo made up some of the cost of his rescue mission by selling off what was left of Forty-niner to one of the salvage outfits at Ceres. They started cutting up the old bird as soon as we parked it in orbit there.

But not before I put on a clean new spacesuit and went aboard JRK49N one last time.

I had forgotten how big the ship was. It was huge, a massive collection of spherical tanks that dwarfed the fusion drive thruster and the cramped little pod I had lived in all those weeks. Hanging there in orbit, empty and alone, Forty-niner looked kind of sad. Long, nasty gashes had been ripped through the water tanks; I thought I could see rimes of ice glittering along their ragged edges in the faint starlight.

Then I saw the flickers of laser torches. Robotic scavengers were already starting to take the ship apart.

Floating there in weightlessness, my eyes misted up as I approached the ship. I had hated being on it, but I got teary-eyed just the same. I know it was stupid, but that's what happened, so help me.

I didn't go to the pod. There was nothing there that I wanted, especially not my cruddy old spacesuit. No, instead I worked my way along the cleats set into the spherical tanks, hand over gloved hand, to get to the heart of the ship, where the fusion reactor and power generator were housed.

And Forty-niner's CPU.

"Hey, whattarya doin' there?" One of the few humans directing the scavenger robots hollered at me, so loud I thought my helmet earphones would melt down.

"I'm retrieving the computer's hard drive," I said.

"You got permission?"

"I was the crew. I want the hard core.

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It's not worth anything to you, is it?"

"We ain't supposed to let people pick over the bones," he said. But his tone was lower, not so belligerent.

"It'll only take a couple of minutes," I said. "I don't want anything else; you can have all the rest."

"Damn right we can. Company paid good money for this scrap pile."

I nodded inside my helmet and went through the open hatch that led down to JRK49N's heart. And brain. It only took me a few minutes to pry open the CPU and disconnect the hard drive. I slipped the palm-sized metal oblong into a pouch on the thigh of my suit, then got out. I didn't look back. What those scavengers were chopping up was just a lot of metal and plastic. I had Forty-niner with me.

The corporation never assigned me to a waterbot again. Somebody in the front office must've taken a good look at my personnel dossier and figured I had too much education to be stuck in a dumb job like that. I don't know, maybe Donahoo had something to do with it. He wouldn't admit to it, and I didn't press him about it.

Anyway, when I finally got back to Vesta they assigned me to a desk job. Over the years I worked my way up to chief of logistics and eventually got transferred back to Selene City, on the Moon. I'll be able to take early retirement soon and get married and start a family.

Forty-niner's been with me all that time. Not that I talk to him every day. But it's good to know that he's there and I can ease off the stresses of the job or whatever by having a nice long chat with him.

One of these days I'll even beat him at chess. ⊡

Nothing is so soothing to our self-esteem as to find our bad traits in our forebears. It seems to absolve us.

—Van Wyck Brooks

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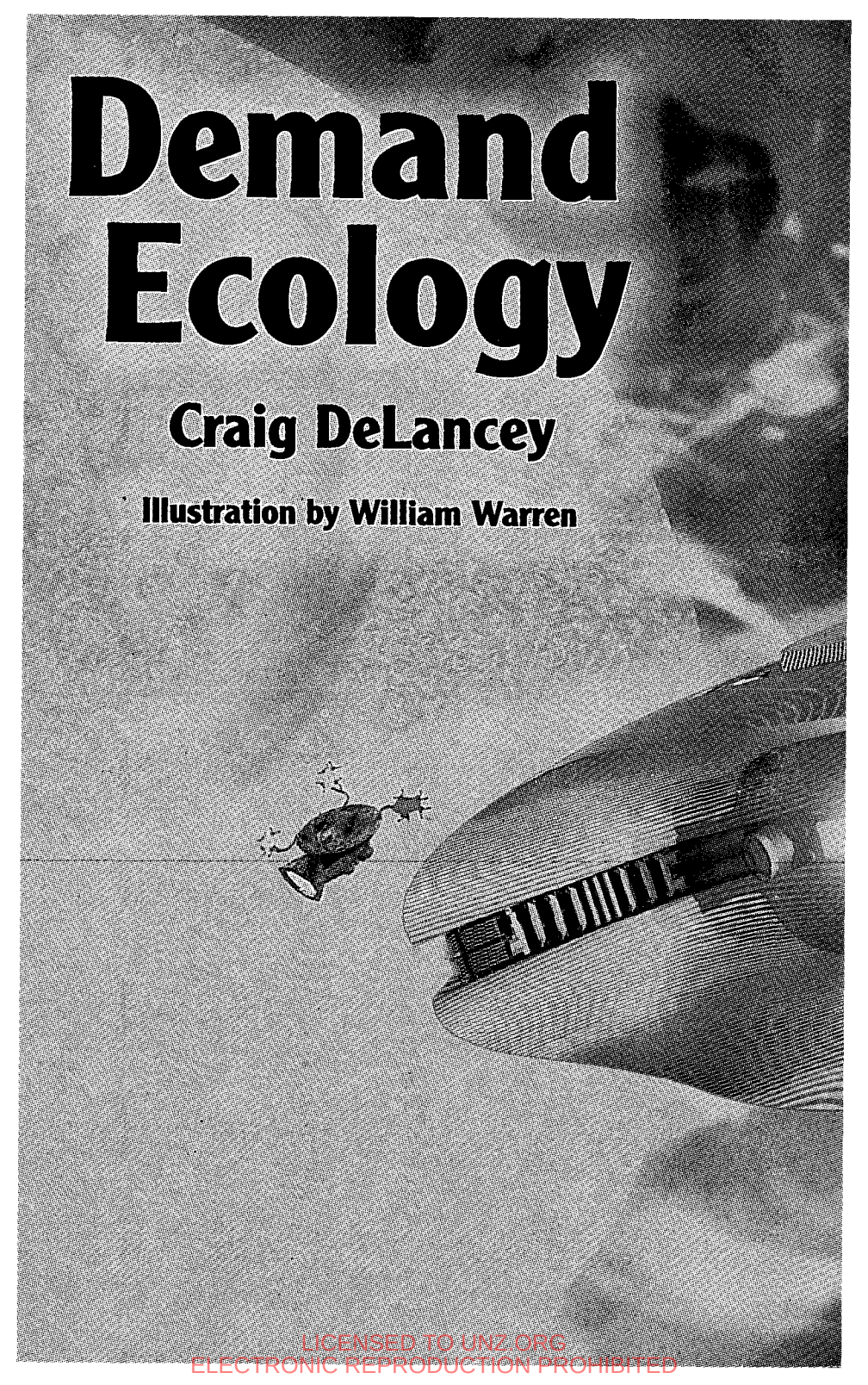
Demand Ecology

Craig DeLancey

Illustration by William Warren



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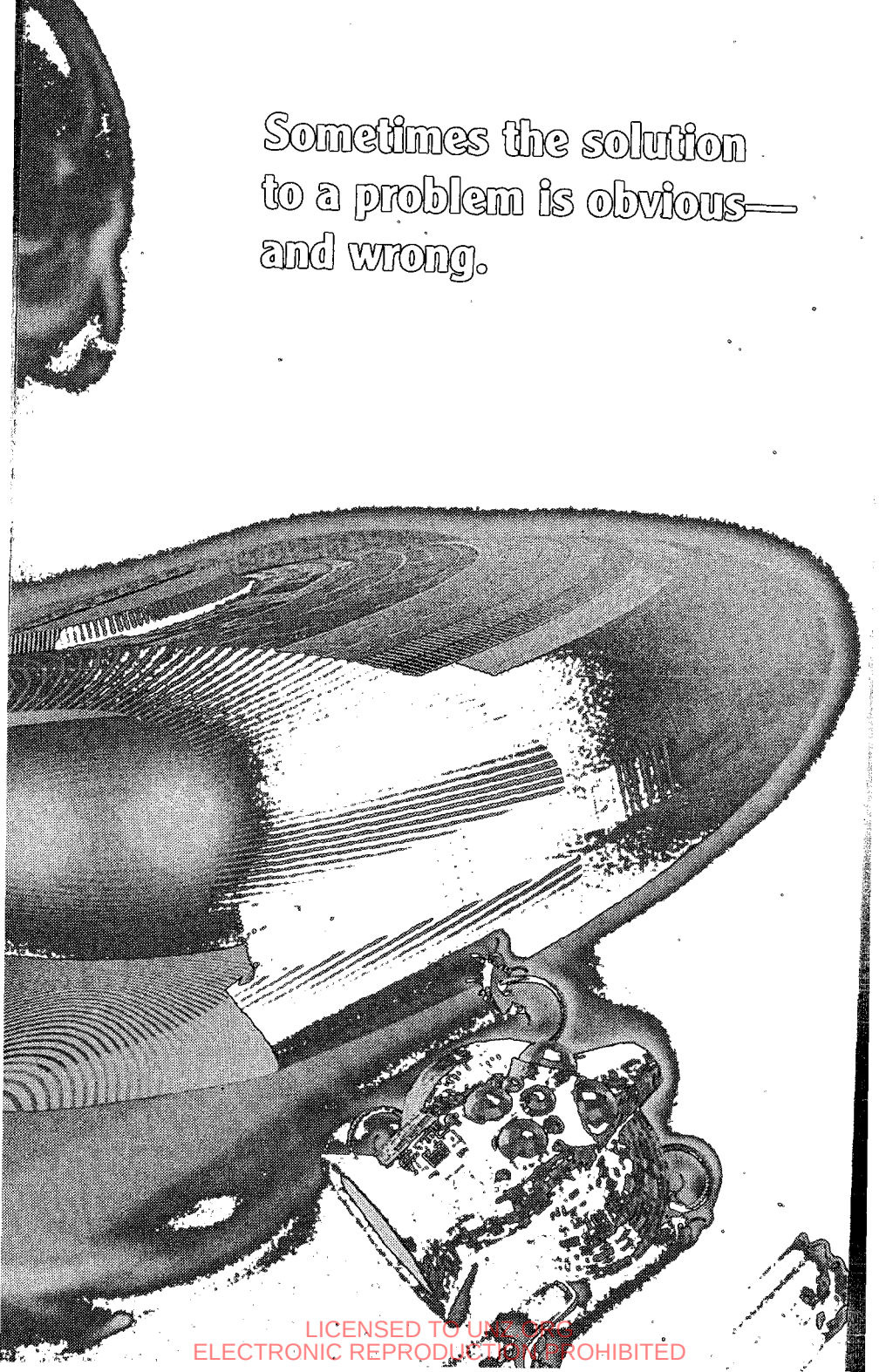
Sometimes the solution to a problem is obvious—and wrong.



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"Give him another injection," the captain said.

A hot burning line shot up my arm. Stimulants.

"No," I grunted. I forced my eyelids up. Only one eye came open. I tasted blood in my mouth and had to struggle to swallow. I pushed my swollen tongue forward and found it touched my bloated lip without resistance: my front teeth were gone.

They had flown me back up to the ship. I was in the med room, strapped to a gurney that was propped up. Commander Ryan and Captain Walters floated before me, roughly aligned as if standing there. The ship's doctor hesitated beside them, a needle in hand.

After a long silence, the captain said to me, "Why did you do it, Virgil? The whole human race had a stake in this. Our first project beyond our solar system. And you sabotaged it. You destroyed everything."

"Alone," I managed.

"What?" The captain barked. For a brief moment, he lost his patience and studied control, and kicked the leg of the gurney, making it shake, sending him floating back. Commander Ryan looked sheepish and ashamed, turning her eyes from this display to look at the floor.

"Must talk to the . . . captain alone."

The captain's jaw clenched as he thought about this. Then he said, "All right, clear the room."

We had arrived in the Purgatorio system a few e-days before. We pushed heavy velocity when we fell back into regular space, and had to sling close to the alien sun to brake for orbit over Purgatorio. The Kirtpau hull performed as promised, which was almost a disappointment—another reminder of how far beyond human science most of Galactic technology reached. We hardly felt the heat as we punched past the corona at .02 c. The Galactic remora probes—tagging us on the odd chance that humans might surprise them and reveal some value—let go of the hull and drifted into steep comet trajectories, fleeing the fusion fire. They would take some tricky turns around the small inner planets before they reattached to our ship in a few e-days.

As we lined up for the orbital insertion, Captain Walters, a huge dark-haired man born and raised in Colorado, called out to me in his rasping voice. "Doctor Virgil, any sign of Greete ships in orbit about Purgatorio?"

"None yet," I told him. As chief scientist, my main task was to advise on our use of the planet Purgatorio's atmosphere. But during our approach the captain had me watching for the neutrino signature of Greete starships in flight. We did not expect trouble from the Greete, but the captain wanted to be cautious.

"Okay. Keep watching." He raised his voice. "Let's focus on this orbit capture. We need to come in close. We're at the limit of our safe speed here as we spin out to match the planet. Stay sharp."

His expressive face, with eyes deeply wrinkled from equally frequent smiling and frowning, was shrouded behind dimly translucent black virtching glasses. The design of our Kirtpau ship eschewed hard controls for virtual interfaces, so the ship interior was unadorned brown and gray walls with a rough texture that resembled stone and that smelled pleasantly of wet slate. The main bridge contained only two rows of hastily added human chairs facing each other. Each of the twelve bridge crew wore virtching glasses and waved in the air at controls that others could not see.

We dove Purgatorio's gravity well low to grab a circumpolar orbit. Apparent gravity shifted as we turned with the orbit, seeming to lift us out of our chairs. I fought nausea and concentrated. I turned my attention to our preliminary probe data: a picture of pale clouds, spotted with dark points that cast columnar shadows into the orange

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depths. These were atmospheric ships and stations of the elusive Greete, our competitors in exploiting the gas giant. There were many more of them than we had expected.

Purgatorio is about half the volume of Saturn, but with 80 percent the mass and a small iron core. Tidal locked, .89 AU from its sun, one side faces always its G-class star, while the other remains in darkness. On the sunlit side, the atmosphere—helium, methane, carbon dioxide, and nitrogen, with a fair amount of water vapor down deep—churned at a mean 875 degrees Celsius. Convection currents rise from dark depths thousands of kilometers below, bubbling up from the equator and expanding explosively before flowering yellow and orange in the stratosphere. Then the winds push out towards the shadow side, where they blow into a dark nearly as cold as space. Methane freezes, helium and nitrogen contract and collapse, and furious catabatic winds plunge back toward the metallic center.

Above those vast and inscrutable depths, no being in the known universe can survive for long except in the high atmosphere along the Twilight Edge, the longitudinal circumference where the shadow and the sunlight meet. Narrow at the equator but wide at the poles, the largest region of the Twilight Edge lies at the North Pole: four million square kilometers of calm atmosphere floats on a layer of turbulent microcurrents of cooling gases, and mild winds circulate at a mere fifty degrees Celsius. Our target orbit would travel above the Twilight Edge, bringing us over the North Pole twice an e-day.

"We have captured orbit," Elizabeth Ryan, the second in command, announced.

A collective cheer erupted from the bridge crew.

The captain smiled and clapped once. "All right, astronauts, don't get too comfortable yet. Start orbit consolidation checks."

"We have a message from the Greete!" Ryan shouted. She waved one arm and a small image of a Greete, looking like an inflated green whale floating in orange and brown clouds, appeared on our virtual desktops.

"Let's hear it!" I shouted.

Ryan looked up at the captain. He forced a smile at my interruption and said, "Go ahead, let's hear it."

"Yes sir," Ryan said. She shared the Greete transmission: a jumble of Galactic Standard, hard to decipher for its speed. Silence fell as we all listened. Tarkos, a young engineer from Turkey and the only person on the ship who knew as much Galactic as I did, struggled to translate.

"We the Greete demand dwelling reason—uh, demand ecology—"

"Stake claim," I interrupted.

"Right, thanks. We the Greete stake claim to this planet. We—"

The captain sighed and waved at Tarkos. "Is it the same message, the automatic message, our probes picked up last week?"

"Looks like it, sir. Same start, same size. And it repeats."

"Okay. That's enough. Tarkos, record this and translate what you can, just to be sure, and we'll review it at the staff meeting. We'll be within our rights if we keep out of their way."

"We can't be sure of that," I blurted out. I was immediately sorry. I still had the habits of an academic scientist and by reflex attempted to start debates. Such interruptions broke no official rules, since I was a civilian, but the captain found them an inappropriate distraction.

He turned to me with his jaw clenched. "Doctor, you know I appreciate your insights as chief scientist, but we really don't have time for this argument right now." On the voyage out he had grown impatient with my opinions of Galactic politics, but he was always polite about it.

"But our understanding of Galactic

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law is negligible. The Kirtpau claim that the Greete are exaggerating their legal stand might be . . . biased in some way." And, I did not add, our desire to accept the Kirtpau account might be wishful thinking, our hope that the Kirtpau told us the truth when they sold us consulting services on our mission to Purgatorio. "We don't even know what the Greete are doing here."

"They're mining matryoshk, just as we're going to do. *After* we get our orbit finalized."

"We're not sure they're here for matryoshk."

"Thank you, Doctor," the captain said, in a tone that made it clear that this was the end of our conversation. "Please get your best reading on the weather down there, so we know if we can drop the pod on our next pass, and what the mining situation is like."

He looked at the rest of the bridge crew.

"Listen up. We need to ease into our lower orbit as we slow. Keep the trajectory tight. Begin preliminary preparations for the drop. Senior staff meeting when we reach the South Pole."

First Contact had come on a warm July day, sixteen years before. My wife Jean was four months pregnant. We were returning from a check-up and she sat, comfortable in the languid heat of our sun-baked little electric car, with her hands folded on her stomach, as I drove us home. She had cut her hair short a week before, the first time I had seen it like that, and now her exposed face, with the added weight of pregnancy, seemed softer. I smiled and patted her stomach.

"How was your day?" she asked. I was a biochemist at MIT, and during the summers I volunteered my expertise to an environmental think tank. I had spent the day there before picking her up at the doctor's.

"Not good. You remember that voluntary pollution reduction plan with the plastics manufacturers? They've done nothing still. They keep stalling, saying they need new studies before they can implement." I sighed. "We have no leverage. Our supporters grew complacent after we negotiated the agreement last year. The manufacturers know it."

She shook her head. "You'd think that with Bangladesh under water and thirty million refugees swarming into India, they'd start to see that the time for stalling on these kinds of issues is over."

"It's always better to do the right thing next quarter," I said. "So it's always better to stall during the current quarter. But enough of that. I'm just glad the doctor said everything is going so well. Steak tonight?" 'Steak' was our ironic name for tofu.

"Please," she said, smiling back.

When we came onto the highway, I asked, "How about some news?" She barely nodded, already starting to fall into a nap.

I was expecting to find some news about Sophia, the first true AI, which had come conscious just a month before. Instead, we heard, ". . . and we can confirm at this time that the extraterrestrial spacecraft is in orbit around the Earth. These are not messages from deep space, but from only a few hundred kilometers above the Earth. So far they've transmitted in English, Mandarin, and Hindi."

Only then did I notice, as I instinctively slowed to listen, that traffic all around me was slower than normal. People were on the phone or leaning toward their dashboards, listening, creeping home distractedly as the whole of human history changed around them.

Jean snapped awake when she understood what was happening. "It can't be," she whispered. "I'll try another station."

"Earlier transmissions," the next anchor announced, "explained that we had achieved one of the four criteria for admittance into what the aliens have called 'Galactic commerce.' These four

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criteria or standards are, uh—" There was an audible shuffling of paper. "—interstellar travel, faster-than-light spaceships, autovo—excuse me—*autoevolution,* and artificial intelligence."

She switched stations again. "—that at this time, we do not expect a landing. The aliens have said our gravity is prohibitively strong for them. Dr. Karen Umiker, our science journalist, is here to explain what that might mean. Karen?"

When we made it home, I parked in the driveway, and we sat there, still squeezed into our tiny car, and listened for an hour while surfing the web on the dashboard computer under the shadow of the dark front of our home. We skipped anchors and pundits and listened again and again to the transmission when we could find it, unable to pull ourselves away from that synthetic, eerily calm voice from space: "We are the Kirtpau. We seek trade with the humans of Earth."

Jean held both hands over her stomach, as if to shield our unborn daughter, whom we had already named Christina.

"Please let them be peaceful," she whispered.

In that, at least, we were lucky.

When we passed the South Pole, the eight senior staff gathered in the conference room. The Kirtpau are like ten-legged crabs with eyes on their knees, about a meter and a half tall, on average. So the interior of the ship had painfully low ceilings but broad spaces. The conference room was long and wide, and our voices sometimes echoed sharply. The four command staff and four lead scientists strapped onto chairs around a table, without virtching glasses, making some show of formality in the microgravity.

The thirty-person crew of our mission was an international mix. The ship was nominally under U.N. control, since the Kirtpau had traded it for resources in international waters, but the U.S. and Britain had used their Security Council domination to force through military control of the mission. The captain and I were American, and Ryan was British. All the rest of the senior staff were Europeans or Indian, representatives of nations firmly in the U.S. block, except for our chief engineer, Kweupe. I sat next to her, at one end of the table. She was a tall, thin Kenyan woman with broad shoulders. She kept her hair so short it seemed she had only just shaved her head, and she liked to rub one hand over the top as she thought. I considered her an ally.

Tarkos's translation of the Greete message confirmed that it was a repeating loop of a message our probes had heard before. The captain tabled discussion of it and asked that we first review the orbit capture. Then he pointed at me. "Science: what's the environment looking like right now? Any problems for the drop or for matryoshk mining?"

Matryoshka carbon is buckyballs wrapped in many nested layers of carbon network spheres. The nested shells could be aligned and twisted into configurations that released trapped atoms, changed current flow, catalyzed reactions, or held particles in quantum isolation. Groups of the molecular structures could be arranged to build quantum computers with long decoherence times, and so matryoshka carbon formed the core component of our best nanocomputers. But it took years to grow small quantities of matryoshk, even in our fastest orbital factories. Down in the churning cold of Purgatorio, black oceans of it had formed over billions of years of crushing pressures and alternating heat and cold. There was enough there to build tens of millions of AIs.

I released my straps and extended my legs, so that it was as if I had stood up. I had to hold one hand over my head to keep from bumping on the ceiling. "The probes we dropped in our pass are functioning. The Greete seem to avoid getting in their way—"

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"We don't need to speculate on their noble motives," the captain interrupted. "What about the weather?"

"Uh," I hesitated, regathering my thoughts. "Well, the high atmosphere looks unusually stable right now. The radar readings of the deep atmosphere show high-speed winds just above the matryoshk, but that was expected. The probes have found some strange things. There is no sign of additional carbon in the polar edge. No hydrocarbon traces. If the Greete were mining matryoshk, there should be something. And another thing: there's been a tripling in the free oxygen in the Edge. It's still a tiny amount, but I looked at the Kirtpau encyclopedia and found that the Kirtpau data from the distant past matches our survey from three years ago. So, it appears these are levels of oxygen in the Edge never seen before."

"Maybe it's a byproduct of some mining technique," Commander Ryan proposed.

"No. If so, there should still be signs of carbon in the atmosphere. And oxygen could bind with and corrode matryoshka carbon, so it could be detrimental to mining. No. There are many Greete ships here. Four hundred and fifty or more, floating from serially tethered hydrogen zeppelins. They look like linked sausage. And there are—"

"Now, doctor," the captain said, smiling broadly. "Don't get too poetic on us. Right now I'm trying to focus us on the issue of the drop schedule. Are there too many Greete structures? Are they in our way?"

He looked at Ryan as he asked this, but I did not sit down, and I answered. "The North Polar Edge is large. Space isn't a problem yet. But we shouldn't drop until we understand what they're doing—"

The captain kept smiling, but he asked me, "So, Doctor, what do you think they're doing, if not mining?"

"I don't know. Building some kind of permanent base or structure. Just that."

"That's your professional opinion, that they're not mining here?"

I hesitated. What was he getting at? "Uh, I guess you could say that. My professional opinion is that they're not mining here."

"And you think there is no competition we need worry about? That we should talk with them? Negotiate some kind of cultural exchange?"

I couldn't see where this was going. "Of course we should talk with them. And they're changing the atmosphere dramatically. We need to understand—"

"Commander Ryan," he interrupted, "would you review with us the probe data from the last several hours?"

I hesitated, my mouth hanging open. Then I bent slightly, unsure of whether I should sit for this. I had reviewed the atmospheric data from the probes. Had I missed something? I looked at Kweupe, who sat rubbing one hand over her crown. She shook her head: she, too, did not know.

Ryan waved and a picture of the Greete ships, floating in the high atmosphere, appeared on the wall. She enlarged and selected perspectives until we saw a close-up of one ship. A black line dropped from the ship straight down into the obscure orange depths below.

"This appears to be a mining rig," Ryan said.

A murmur went around the room. The captain looked at me.

"We don't know what that is. . . ." I said hesitantly.

"We have radar data," the captain said. "It shows the pipe runs all the way down to the matryoshk layer, and stops right there, in the middle of it."

"But—"

"Doctor," the captain said with a tone of exaggerated incredulity. "What more evidence could you need? You get yourself an invitation from the Greete to come down and inspect a ship, and then we'll talk."

A couple of crew sniggered at that.

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"Commander Ryan, update our fuel situation," the captain continued. Ryan stood. I slowly sat and strapped myself down.

When my daughter Christina was six she asked me, "Daddy, why are we poor?"

We sat at the kitchen table together. It was after school and the bus had just brought her home. I gave her a banana and a glass of soymilk and asked about her day. I got in response this question.

"Why do you say that? We're not poor," I told her. "By the standards of most of the world, with its millions of wandering homeless, we're rich. And here in the United States, we're middle class. Or working class, maybe—a professor's salary is not much."

"I meant everyone. On Earth. Why's Earth poor?"

"Who told you Earth is poor?"

"Morgan," she said. Morgan was a girl in her kindergarten class. "She said Earth's poor, and the Galactics won't even talk to us 'cause of it."

Out of the mouths of babes. "Well, the Galactics don't measure wealth just in the way we do."

"What's that mean?"

"They . . . well, we think of wealth as things one person has. And we mostly measure wealth—we say a person is rich—if they have money, and a big house, and machines. . . ."

She nodded. She held the banana, forgotten, in a little fist.

"The Galactics measure it that way, too, but they also include something else. To most of the Galactics, wealth is more shared because it mostly comes from ecoforming planets—that's changing dead planets, poisonous planets, so that something can live on them. That gives you more living room, more resources, more everything. But ecoforming is really, really, really hard. And it takes a long, long, long time."

"Like a millin hundred years?"

"Well, not that long. But hundreds of years, with thousands of people cooperating."

"Helping together," she said.

"Right. But the Galactics only cooperate with species that've proven they can be trusted for centuries or even thousands of years. And the Galactics suppose that one way you show you can be trusted is that you've preserved your own world and created great things that take a long time. Some economists call that a 'trust economy.'"

"Did we make anything great for a long time?"

"Well, we haven't really made anything like the Galactics have made. And nothing that takes a long time. Take a bite, honey." Bananas were hard to get, with most of Central America desertified. I had splurged buying a few for her.

She chewed for a moment. "Morgan says the Galactics hate us 'cause we killed all the animals here."

"The Galactics don't hate us, honey." Not much, anyway. Killing most species of megafauna on your planet is about the worst act possible in Galactic culture. But they still occasionally sent a probe by, as if to spy whether the filthy cannibals were up to something interesting. The Kirtpau alone traded with us. We didn't know if they were bottom feeders, or saw some value in us, or took us on as a charity case. Maybe all three. "But trust is earned mostly from ecoforming—"

"Puttin' life on planets."

"Right. And conserving life on your own planet. Those work together. The way to ecoform is to use organisms that can live on a planet and change it over time. Having more of those helps." In a flash of inspiration, our best translator of Galactic had summarized the central moral of High Galactic Culture: the business of life is life.

Christina nodded. "That's why the Kirtpau gave us spaceships for our worms and crabs and stuff." The Kirtpau traded us three FTL ships in exchange for exclusive galactic use rights

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of all the thermophilic life clinging to deep sea vents in Earth's oceans. At the time, humans laughed at the Kirtpau for the exchange. We were given the stars and they got mostly samples of bacteria and nematodes. Years later some economists claimed that the Kirtpau paid us half the market value of those rights.

"Yes." I took the banana, peeled it down a bit farther, and handed it back to her. She hooked her long hair behind one ear, a gesture I adored, and I put one hand on her cheek for a moment and smiled. "They're using those bacteria and animals to help ecoform a moon with volcanic seas. They didn't have animals like that of their own."

"Why not? Did they kill them?"

"No. No honey. Just, their home is what we call volcanically inactive."

She nodded uncertainly.

I continued, "So our animals are going to help prepare for later when their own animals will be put on that moon."

"But why did we kill all our animals?"

"We didn't kill them all." I waved at the window, as if you could see lots of animals out there now, in our empty little yard.

"Why did we kill lots of 'em?"

"Finish your banana," I told her.

"But why?" She took a bite and then handed me the peel.

What could I say to explain the sixth great extinction? Because we didn't care? Because we are evil?

"I don't know," I whispered.

"We shouldn't'a," she mumbled through a full mouth.

"No, we shouldn't have."

I stewed through the rest of the staff meeting. I couldn't concentrate on Ryan's summary and the presentations that followed. I was confused. The images of the Greete formation did seem to indicate matryoshk mining, but none of my other data was consistent with that. And I was angry that the captain had intentionally humiliated me. When the captain announced the meeting was adjourned, Kweupe leaned toward me.

"Don't let that get you down," she whispered in solidarity.

I nodded in thanks.

She frowned in thought. "But you need to . . ." She hesitated, and then decided not to finish the thought. "Come see me in engineering, when you can."

"Okay."

I sat while the others left, until the captain and I were alone together. He floated as rigid as wood, at a slight angle from the floor since he was too tall for the low ceiling, waiting for me to speak. Stretched across his chest, his shirt seemed ready to burst. I unbuckled my seatbelt, pushed toward him, and oriented in line with him.

"That was uncalled for. You set me up to look bad. You asked me all those questions, when you'd withheld data from your chief scientist."

He furrowed his brow in exaggerated concern. "Doctor, I'm sorry you feel that way. You did have access to the same data we did. . . ."

"But I was looking at the atmospheric data, as you instructed."

"Maybe you weren't looking for anything that contradicted your expectations."

To this I didn't know how to begin to respond. "Wha—you think—"

"Understand, Doctor, I appreciate your special concern about the Greete and other Galactics. But the U.N. gave us a mission and I have to see it gets done, no matter how interested I personally might be in your concerns."

"But things are changing all around us, and the U.N. isn't here to consider the facts as we discover them."

The captain nodded with big, exaggerated movements. "I see your point, I see your point. But, you know, there might be some people on board that feel just the opposite way about things here. They might look at the Greete and say, who are they to tell us about what they claim the rules are?" He spread his hands. "Can you see *their* point?"

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"No. That has nothing to do with the fact that we have to live with these civilizations, and so we must—"

But the captain continued right over me. "If we start changing the mission out here, how are we going to determine what changes should be made? Really, that's not up to us. The U.N. gave us clear instructions."

"But it is up to you."

"That's right, that's right. And I'm telling you that I decide to finish the U.N. mission as the U.N. laid it out for us."

"But we have to worry about whether the Galactics—"

"Well, I'll be honest, Doctor. I don't appreciate this doubt that settles in regarding the Galactics. As if we humans are always making mistakes. I think that's just not good for the morale of the crew. Or the human race. Don't you agree?"

"We made mistakes," I said, speaking more quietly. "The human race made mistakes. That's a fact. We don't want to keep making them."

He nodded again and smiled, showing his teeth. His eyes, however, were cold. "That's one perspective. And I thank you for bringing it to my attention."

I stared at him, my mouth open. Once he started thanking me, I was sure he was no longer listening. I had asked at least a dozen times, during the trip from Earth, whether I could work with Tarkos to prepare a message to the Greete, and the captain had thanked me profusely each time—but he never gave Tarkos permission and he never allowed a senior staff meeting agenda to include discussion of a message.

And now here we floated, with the captain towering over me, two meters of determination, refusing to submit to doubt. This was the human order, before First Contact: inertia plowing through caution.

"We must try not to make the same mistakes," I whispered.

"Thank you for your perspective, Doctor. And if you have any evidence that we're making a mistake, I promise you that I'll consider it and if you make your case, I'll do everything in my power to fix it. How does that sound? Good? Meanwhile, Doctor, work on using your great talents to help us get the job done. Thank you."

Then he left me there, my face burning red with anger. And with doubt.

"Why didn't you do anything?" Christina asked me one night during dinner. She held her fork in one hand and stabbed moodily at a potato on her plate. Her eyes shifted from me to her plate and back to me.

By the time Christina was thirteen, she had tuned the smartpaint of her bedroom to full color images of the galaxy's greatest cities. Neelee-ornor, with its white spires threading the canopy of the galaxy's largest trees, beside a space elevator strung with flowering vines so that it rose like a yellow column into space. Kirt, the ocean city capital of the Kirtpau, with vast, glowing spiral structures of solid diamond, reaching for the distant sunlight or gyring down into abysmal depths, obscured everywhere by schools of luminescent fishlike creatures of every conceivable color, swimming through dense sea jungles. Jerriat, the floating city of the Hmmnarout, where, like hanging gardens, the living floranets drooped from metropolis balloons down into the thick atmosphere of their gas giant, swarmed everywhere with four-winged flying lizards.

On television, gray-haired men mocked Galactic Civilization, the alien values, the indifference to humanity and Earth. Elections were won by politicians who spoke of "human pride." School boards faced weekly fights over when our textbooks would return to "balanced teaching" of the glories of terrestrial accomplishment. But some of the young of Earth, who felt absolved of our guilty past by the accident of being born after First Contact, were developing

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their own understanding.

"Why didn't you do anything?" Christina repeated. She pressed her lips together into a frown.

"What do you mean? About what?" But I knew.

"About everything. Why did you collaborate?" She flashed a look at me, then stabbed the potato hard, splitting it.

"Collaborate? I didn't 'collaborate.' I was a Green. There were only a few Greens in America then. We were rare. I spent all my spare time—"

"But what did you *do?*" She interrupted.

Jean frowned at this. "Your father spent a lot of time working on these issues. Time he could have spent doing corporate consulting instead, for real money. God knows we could have used it. And I helped when I could, too, after you went to school."

"Okay, but what did you *do* about everything?" Christina repeated, emboldened, straightening a little.

I explained haltingly about my many years of volunteer work for NGOs. "But everyone resisted us," I concluded. "We were committed to nonviolent change, and the electorate just ignored us. But I helped negotiate industry agreements to reduce pollution, to preserve habitats. . . ."

"It didn't help, did it?"

"There was a lot of . . . debate about what kind of damage was occurring, and then debates about how the agreements should be enforced. We didn't have the power to stop that, to make things go faster, to go fast enough."

She sighed and pulled a string of hair behind her ear. The gesture had lately been preceded always with a sigh, imbued with impatience for me, for Earth, for humanity. As if she meant to pull all those impediments behind herself.

I had a sudden confusing flash of a conversation years before, with me at a lunch table chastising my parents for their impossible complacency. This image prodded me into a sudden impatience. "What did you want us to do?" I demanded of Christina. Had my father asked that of me?

"I don't know. Something. Shut down the companies and governments that were destroying everything. Go to jail. Refuse to live like that. Anything."

She speared and split another piece of the disintegrating potato.

Christina asked The Question many more times over the next year. I gave her a different answer, a new evasion, each time.

"But," she doggedly concluded, having always the last word. "You didn't really *do* anything."

Still shaking and hot faced, I retreated to the quarters that I shared with three other crewmembers. It was a small cabin, and my hair brushed the lights if I stood, but I pushed back and forth off the walls, like a fish in a small tank, floating side to side. My roommates were at their stations, so I had some solitude. And I could work here, with virtching, just as well as on the bridge or in the engineering hold.

I wasted half an hour pointlessly reviewing what I should have said, mumbling aloud, waving my hands. A ridiculous figure. I finally pulled my virtching glasses on and opened my desktop. The probes were still transmitting good data. I reviewed the visuals. Some small and pale objects circled the Greete ships. I ordered some close-ups while I went over the atmospheric data. There was no doubt: the methane count was slightly lower than we had found before, and oxygen was up. And there were still no chemical symptoms of matryoshk mining.

The new pictures came back. The small figures were long, cylindrical shapes, pale green, with broad vanes along the sides, and one end spotted with dark circles. These were Greete—naked in the outer atmosphere! I quickly ordered more close-ups. One showed a glint of sunlight before one Greete, re-

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vealing that they wore on the front large clear covers of some kind. A breathing mask, most likely.

The Greete homeworld is a methane giant, where the Greete float in the highest cloud bands on the natural hydrogen sacks in their bodies. The conditions are similar to those in the Twilight Edge of Purgatorio, but with a few important differences: for the Greete, Purgatorio is too heavy, gets too much UV radiation, is too warm, and the atmosphere is thin, with too little helium and not enough CO_2. Yet here they were, moving in the atmosphere—going native.

I needed to know several things immediately. More on Greete biology. More on the air flow figures for the North Pole of the Twilight Edge. More on matryoshka carbon pools. I grabbed the ship network icon and dug out the Kirtpau Encyclopedia. I opened the files on the Greete. After an hour of reading, I had formed a clear theory of what was happening.

"All drop crew, prepare for drop!" the intercom sounded. Then the drop preparation alarm chimed twice. They were preparing the deployment of the air factories, scheduled for our next pass over the North Pole. I looked at the clock. There were only two hours left.

I sprung out the door and pulled myself as quickly as I could toward engineering. I had to halt the drop.

"So you're going to go?" Christina asked me one evening as I drove her to a practice session for the National Scholastic Bowl. She was fourteen, and her junior varsity team was preparing for the state competition. The topic of the competition was to be Galactic history. She considered it her strong point.

I had just gotten the call from the U.N. the day before. Jean and I had stayed up late, debating the pros and cons, but we knew in the end that we would agree that I should accept. The only thing left was to tell Christina.

Christina's hair was up, and it made her look older, almost severe. A single strand fell down over one cheek, and before I could stop myself I reached over and hooked it behind her ear. She frowned and pulled away.

I put my hand back on the steering wheel. We still had the same electric car, small but dependable. Perhaps like me, I thought in my more sentimental moments. "Right. There was wrangling at the U.N.—the U.S. wants an American lead scientist, since they're trying to control the mission. The compromise was to send a Green with international connections. But honestly, I'm the best person for the job. They need a scientist with experience running large teams and big projects. And they need a biochemist that understands how fluid volumes of high-complexity carbon structures behave under pressure. There are only three of us who've worked on that, and I'm the most well-rounded, having published also on atmospherics of gas giants—"

Christina turned back to the window, tuning out the technical details.

"Anyway," I concluded, trying to recover her attention. "I'll go into space. Another world! Purgatorio!" I didn't talk yet about how long. Launch was a year away and I felt that the painful questions could wait.

"What for? We can't terraform it."

"But there is matryoshka carbon there. Billions and billions of tons of it, down in the lower atmosphere. The U.N. wants to start a mining operation to pull it up. We can use it in our AI program." This was an essential part of humanity's plan to climb to galactic wealth. Having no trustworthiness in the Galactic economy, we turned to developing technology commodities with the resources we could get. Nanotech AI was the primary investment gamble we had chosen. We had discovered that, because of the labor-intensive demands of fostering artificial intelligences, AI manufacture was the sweatshop work of

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the galaxy.

"And what about the Greete?"

I jerked my head to the side to look at her. "Who told you about the Greete?" I had been instructed not to speak of them. I assumed their presence on Purgatorio was secret.

"Znet."

"You read *Znet?"* I was surprised. I had no idea that she read political web sites.

She shrugged. After a minute she said, "They're already there, right?"

"Yeah. They're there. But they don't own the world, and they're not ecoforming the planet, and there is plenty of matryoshka carbon, so we expect no conflict." These were the justifications I had been told.

She thought about that for a while. "So we're not going to make anything there, or stay, or do anything with the Galactics there now. We're just going to squeeze in next to them and take this stuff and bring it back here? No long-term project. No real increase in—" And she used the translation of the Galactic term for wealth and trustworthiness. "—lifewealth."

"Well, there'll be a permanent base there, at the North Pole, where the atmosphere is stable. We'll bring air factories, so we can stay as long as we want. And big blimps to make a kind of floating town. But, I'll be back soon, and, yes, we're going to bring the matryoshka carbon back. But we're going to make something with it, right?"

She stole a look at me, frowning, as if to say that we both knew that was not the point. Then she turned and said to the window, "I understand we need the matryoshk." I was surprised again: she knew the slang term for the carbon. "But we should negotiate with the Greete, tell them what we want to do and find some way to build something there with them. We should prove we can . . ."

She didn't finish the thought. We drove the rest of the way in silence. When I pulled up in front of her school, a dreary overcrowded building stuffed with a resentful mix of suburban kids from old local families and the children of newly bereft refugees from some drowning coast or other, I asked, "So, can I help out tonight—I mean, with the practice? You know Galactic history is my hobby."

"No!" She answered too quickly. "Uh, no thanks. See ya, Dad." She snapped off her seatbelt, hurried out of the car, and pushed the door closed behind her back, already running. I watched her race into the school and leave me behind.

In Engineering, a crowd worked in hushed, intent voices as Kweupe calmly but hurriedly gave out orders, occasionally pausing to run a hand over her head while she thought. The captain floated nearby, silently watching.

"We have to stop the deployment!" I shouted as I dropped through the ceiling hatch.

The captain looked up at me, his expression a mixture of surprise and anger. "What?"

"We have to delay the drop. I've discovered what the Greete are doing." I managed to get a grip on the floor and to turn myself slowly over to align with Kweupe and the captain.

"The Greete are attempting to colonize."

"Maybe this is not the time—" the captain started.

"They come from a Jovian gas giant. They have an amazing metabolism, a mixture of methane and photosynthesis metabolisms. They probably evolved from symbionts—"

"Doctor," the captain said firmly. "Our schedule is tight right now; the drop window is closing. Maybe after the pod is secure you can tell us more about these Galactic wonders." But Kweupe and a few of the other engineers had turned from their work and were listening carefully to me.

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"Just give me one minute! They breathe methane and CO_2. Their bodies use the methane with oxygen to make CO_2 and water and heat. Then they photosynthesize with the water and the CO_2 they made, plus some extra CO_2 they breathe, and make sugar and oxygen. The oxygen feeds the methane process, but they also exhale some of it." I added in a rush, "There are efficient oxygen breathers in their home planet's atmosphere, and—"

"I'm not sure this has anything to do with our drop," the captain interrupted. "It's all interesting, but we can talk about all of this after the deployment."

"Listen!" I shouted. "With small changes to themselves the Greete could live in the Twilight Edge. They want to colonize here. And they exhale the oxygen. That's why we see the spike in free oxygen. Normally that would be no problem, the oxygen would blow away, and there is not much of it, but currents in the pole change frequently, and right now the atmosphere is eddying around in a circle. That could last centuries. Their oxygen is collecting like smog over Los Angeles. In a few decades, it could be a real problem.

"So the Greete have started to collect their oxygen waste. And they are pumping it down into the deep atmosphere. Into the matryoshk. *That's* what the pipe dropping down into the matryoshk is. Not a mining rig."

A murmur went through Engineering. After a long pause, the captain swore. "If that's true, they're destroying the matryoshk!"

"Yes. But they need to get rid of the oxygen. It will bind with the matryoshk and be sequestered down there."

"We need the matryoshk!"

"Yes. And we need oxygen. But—"

The captain's face turned red. "I'm glad we agree on something."

"Listen! Our air factories are going to crack water into hydrogen and oxygen. We'd breathe the oxygen and expel the hydrogen. But here, the hydrogen would bind with nitrogen and form ammonia. We would poison the atmosphere for the Greete!"

Silence fell. Everyone looked at the captain, waiting.

The captain nodded and pursed his lips. Then he called out, in a clear voice, without hesitation. "If that is true, it is important and we need to reconsider policy. But this doesn't mean we shouldn't follow our deployment schedule. The air factories are not scheduled to start for another seven e-days. We'll have a staff meeting after deployment. Then we can study this further. We can determine whether the factories need to be modified in some way."

"We can't drop! What if the Greete can tell what they are for? What will they think?"

"You may be right about the chemistry, Dr. Virgil. But the politics, the diplomacy of this is a matter for the whole senior staff. I'll schedule a meeting for after deployment. We'll keep the air factories inactive until we review your . . . hypotheses."

I groaned. "We know how that will go. We've been there before. My hypotheses will be difficult to confirm quickly so we'll start the air factories, and then since the factories will be running the issue will become how to reduce the hydrogen waste. On and on. Once we drop the factory ring and start mining, the pressure to continue will be overwhelming."

"Doctor, there are procedures to settle these matters. You lecturing us is not one of them. Now, everyone get back to work!"

Slowly, crew turned away, whispering to each other as they drifted to their workstations. The captain floated next to me and opened his mouth to speak, but I interrupted him.

"But I have an idea. A plan. We can exchange our CO_2 for their oxygen. We can create a kind of . . . industrial ecology with them. It may not balance exactly but it could solve both our problems."

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After a long pause, the captain nodded. "Thank you, Doctor. That's very interesting. Thank you for that. I think you should work on that. Put together a plan and—"

"But you must hold off the drop while I do it!"

"No need for that." He was smiling and nodding now. Again I felt that he did not even hear the words I was speaking. "Why don't you go to your quarters and prepare a presentation for the meeting? Outline some of these ideas?"

"You need me on the drop."

"But you need to prepare as much evidence for your hypotheses as you can, before our meeting, don't you think?"

"No one understands the weather in the polar edge better than I do. Same for the air factories."

"You said the weather is stable. The deployment will go fine without you. It's mostly a matter of piloting. We need you to—"

I drew myself erect and spoke sharply. "I spoke my mind, but I've always gone along with the program. Haven't I? I've always . . . cooperated."

He was silent a moment, and in that moment Kweupe called from across the room. "Dr. Virgil, I need you to look at this."

The captain hesitated. I pushed away and left him there, without looking back.

Kweupe floated holding onto a free latch on the drop pod. "There is too much pressure in cell six," she said.

I checked the gauge. "That's the differential from the higher pressure in the ship. The relative pressure monitor is on. We can turn it to ready and then vent the cell."

"Ah, I see!" Kweupe said ostentatiously. She put her hand on my arm, and spoke more softly. "Listen, if what you say is true, then many of us will oppose starting the factories."

"Why didn't anyone speak up, if that's the way we feel?"

"Well, I guess because it was all so fast. We can't decide that quickly. And, well, you need to show . . ." she hesitated, looking for a word as she rubbed the crown of her head. ". . . some optimism."

I pulled back a little bit in surprise. "For captain Walters's schedule?"

"No, no. For yourself. For us. For the mission. Offer an alternative once in a while. Don't just point out what's going wrong or what should be stopped. Point out what we can do."

Another engineer called her and she pushed off, before I could explain that I did have a plan. I looked behind me then and saw that the captain was gone.

Kweupe was right. I had rushed the bad news first and had not made time to explain my alternative to the plan that had taken years of work. I had boxed Walters into a corner. And yet, it seemed too late now for alternatives. If we dropped the air factories, would he be willing to reconsider their use?

Two engineers floated past me. One tossed a tool to the other as their paths crossed, and the other elegantly caught it with an imperceptible shift of the hand. An effortless ballet. All the motion in the room seemed nearly random until you focused on this or that act. Then you could see in all of it the inertia, the inevitability and incorrigibility, of human action. Nothing could put it at rest. I had spoken, I had registered my disagreement, I had told the captain my alternative plan, and now that was over and done with, and there was nothing I could do, everything would continue on its trajectory—

I had drifted toward the converter cell that I had examined with Kweupe and bounced now against the ring where this air factory unit would attach to its lift zeppelin by a single buckycable. I stared at the connection, upon which everything depended. Then it hit me. *Upon this link everything depended.*

Shaking, moving too quickly to reconsider, I chose the only option I could

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think of.

"Where're you going?" Kweupe called as I floated out the door.

"I left my virtching glasses in my room," I lied. They were in my pocket. "I'll be back in time for the drop."

I headed for the medical center.

The Greete transmitted no message and took no action as we came over the North Pole and dropped our pod. The pod tumbled when it hit the troposphere, scraping hot against the helium and methane. There were four of us on board. Erin, a Navy pilot and engineer, was out of sight in the control capsule below, where she steered our drop. She yelled through the harrowing scream of the atmosphere, in triumph and defiance and perhaps fear. In the main cabin, Ryan and I sat facing each other. Our seat-straps held, but I had forgotten to zip one of my pockets closed and my personal tablet computer slipped out and shattered on the ceiling, and then flung about the room. Ryan swore as it hit her near the eye, knocking at her virtching glasses.

"Damn, sorry," I called.

She grunted and scowled, but was goodnatured enough to let it go at that. I tapped my breast pocket, checking that I had remembered to zip it closed over the syringe hidden there.

We clutched our seats and waited for the spinning and flipping to end as the pod rattled and threatened to rip apart. Then we were through the violent rages of the upper atmosphere. Our parachutes deployed and the pod straightened with a joint-snapping jerk. Outside, the atmosphere stopped hammering at us like a tumble of stones and simply roared with a fiery determination to beat at our intrusion. We waited, listening to the howl, as we slowed, sinking into the heavier gravity.

"Deploying Jovian-balloon," Erin called. The descent pod shuddered, and we settled into our maximum weight as the zeppelin of heated hydrogen began to expand above us and provide lift.

It was time. I unlatched my belts and climbed over my seat, feeling as if I were made of lead. I spun open the hatch behind my seat.

"Hey, that's dangerous!" Ryan shouted. "Stay in your seat!"

I ignored her and climbed awkwardly through. Then, refusing to meet her eyes as she shouted at me again, I closed the hatch and locked it.

A short tunnel led back to the engineering core. Kweupe sat at a broad array of monitors, managing the release of the heat shields. She did not notice as I climbed behind her.

"Drop processor chain," Erin's voice called.

"Dropping processor chain," Kweupe responded. I waited while she tapped away a series of confirmation instructions.

A metallic clanking confirmed that we were releasing the long line of armed atmosphere converter cells, each with its own zeppelin, but linked together with a buckyball cable that would hold them in a loose ring thirty kilometers in circumference. The pod bounced up and swayed as we lost the weight.

"Latitudinal jets firing," Kweupe said. "The chain is opening . . . diameter at five hundred meters. Six hundred meters."

I took the syringe out and stuck it in her arm and shot her with two ccs of hibernation prep. She looked up at the reflection of me in a dark monitor above her chair, eyes surprised and hurt and questioning.

"Sorry," I told her.

She slumped forward.

I slipped Kweupe out of her straps and dragged her behind the chair, and then sat. There had been a tiny chance that the buckyball cable could tangle with the pod. Explosive links bound the atmosphere processors to the cable and to their zeppelins. As the chief scientist, I knew their secret firing codes. I sent the messages, all the messages, and their

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tethers exploded. Thirteen water converters, prickling with weapons to defend them should that prove necessary, dropped towards the metal core of Purgatorio. The zeppelins, bearing only the weight of the buckyball cable, shot for the high sky.

Shaking with fear now that it was over, I watched on the monitors as the air factories plummeted.

In the main cabin, Ryan figured out what had happened.

"Virgil!" She screamed, a howl of rage and despair. "Bloody hell! Virgil, what have you done? You—You—" She choked on her anger and confusion.

"Something," I said to myself alone. "I finally did something."

"Doctor, I think you'd best open the hatch!" The captain was on the ship, but they radioed his voice down to the pod's comm system, and the small comm speaker crackled with overloaded volume as he shouted.

"In a while," I said. I was trying hard to cling to some shred of courage and dignity. I knew that I should open the door immediately, but I hesitated, hands over my mouth, afraid of what I'd done. "I want everyone to calm down first."

"I'm bloody going to . . ." Ryan sputtered, loud enough for the comm on her side of the door to pick it up. "A million years in the brig! I . . ."

This was oddly reassuring, that she could speak of my act as a disciplinary matter. I rose, climbed down the access tunnel, and opened the main hatch. Ryan reached straight in and, in a moment of impetuous anger, grabbed my shirt collar and dragged me out, into the main cabin.

We both misjudged the heavy gravity. I could not turn my body in time as she tugged at me, and I fell forward over my chair. I held out my hands but failed to catch the seat, and my head clipped the hard edge of the armrest just over my left eye, before I dove, face first, onto the metal floor.

All went dark.

"All right, clear the room," the Captain said, after they got me back into the ship and they woke me and I asked to be alone with him.

"Sir, perhaps—" Ryan began.

"I'll tell . . . everything," I whispered through my broken teeth. "But only alone . . . with the captain. No recording."

"I'm not sure that's advisable," Ryan said.

That was enough for the captain. He wanted to be in charge of this disaster. "Thank you, Commander, but I'd like you and the doc to wait right outside. I'll see what he has to say. I'll fill you in afterward, Commander."

Ryan glanced at me, her mouth open, but then said nothing and left with the doctor, closing the door behind. The captain told the ship's computer to stop recording.

"Why?" he asked.

I looked him in the eye and gathered my breath. "You can still fix this."

The room swayed and I closed my eye.

"Hey," the captain shouted. "Wake up! You . . . wake up!"

I opened my eye again. His face was close to mine now. Red with anger.

"We don't need the air factories," I continued. My mouth hurt horribly, but slowly my head began to clear as the stimulants took. "We need oxygen, and the Greete need to get rid of oxygen. Like I said before: we can form an—" I coughed and spit out blood. The captain shifted aside and let the spherical red drops drift past, swinging end over end. "We can make . . . a simple trade. They pump their oxygen to us. We release our CO_2 into the polar atmosphere. It will be easier to manage . . . than the atmospheric factories. It was going to take a lot of work to find the water we needed. We can focus on the mining."

"I told you I would consider your plan, Doctor. We could have pursued

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that with the factories in place."

"It was all predictable."

"What?"

"The mission was already laid out for us, and your job is to see it gets done. Deploy, start the factories, and keep alive an endless debate while we slowly poison the Twilight Edge."

He shook his head. "So this is it. You wouldn't trust me. So you threw away the whole human race's project. Doctor, I'm going to have to lock you up till we can get you back to Earth, where you will stand trial and go to prison for what is likely to be the rest of your life."

"Maybe. But it's not over. We can mine matryoshk, if we form an alliance."

"Well, Doctor, what makes you think the Greete will deal?"

"We have some things in common. Few other species are so poor as to be unable to lease a more hospitable world, and so ambitious as to challenge this one."

He shook his head and sighed.

I spit some more. "You have to try. There is no other option."

"I suppose you think you will do the negotiations."

"You send Tarkos. And me. We're by far the best speakers of Galactic you have. The translation programs aren't dependable. And it has to be an atmospheric chemist that makes the deal." I tried to smirk. "You can say you forced the terrorist to help fix his wrong before shipping him to Earth for trial."

"And prison."

He glared at me. I stared back. Neither of us blinked.

The captain finally sighed. He turned away and opened the door. "But you're wrong," he said, pausing in the doorway. "You could have trusted me."

He pulled the door closed behind him. I said to the blank panel, "But now, I don't have to."

The day I left for the spaceship, Jean and Christina took me to the airport. Christina, now fifteen and as tall as her mother, hung back as we walked through the airport, grunting in answer to our questions, making it obvious that she resented being quietly forced by her mother to tag along. I pretended cheer, as I reminded my wife that eighteen months would pass quickly.

"Remember that time your father was sick, when I was in graduate school, and you had to go home for six months?"

"Yeah," she said, smiling sadly. "That wasn't so bad."

"On the other hand," I added quickly, "don't get too comfortable without me."

"And don't run off with some Kirtpau woman."

"Hmm. They're scheduled for only one rendezvous with us. Besides, unfortunately for me, with the three genders, I'm not sure which count as women."

Christina rolled her eyes.

We had come to the security checkpoint. A loose line of people stood unhappily bound behind a meandering maze of strap partitions. It was not crowded—airports were detritus from a past age, and the new electric planes were too few and expensive for most people. If the government were not paying, I would have taken a train like anyone else.

But I stepped to the side and hugged Jean. Our eyes glistened with first tears. I reached for Christina. As she saw her parents' tears, her stoical teenage impatience melted. She hugged me and held on.

"It's a long time, honey," I whispered. "I'll miss you. Be good. Work hard at school. Try . . ." I fell silent. It was useless to continue with such platitudes. After a moment, she stood back and looked at me. I reached out and pulled a strand of hair behind her ear, and she let me do it.

"Bye, Dad," she whispered.

"I'll try to make you . . ." I began. Then I started again. "I mean, I'll try to do better than—than we've done in the past."

She nodded.

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I had broken eight teeth, fractured my skull, and sprained my neck, but after a few days I was patched up well enough to travel. Under escort they took me to the glider. Kweupe stood outside the airlock, making a show of checking over the prelaunch.

It took a terrible effort, but I stopped and looked her in the eye. "Sorry."

"That was not what I meant by optimism."

I nodded and dropped through the hatch.

Ryan was in the glider.

"I didn't mean to bust you up before, all right?" she said, as we both strapped into our seats. She had left her virtching glasses behind, since we did not want to be blasting our network at the Greete positions, and she had the uncomfortable look of someone who feels unplugged. "It was a botch up. But you'd best do this thing right. You understand?"

I said nothing.

"Really, Professor," she continued. "There are people on this ship who would like to blow you out the airlock if you don't set things aright. And I think the captain would feel inclined to let them."

"I understand." But I was trying not to be concerned any longer with the captain. His kind would pass. As would my kind. Better generations would follow.

"Everyone ready?" Tarkos asked with boyish enthusiasm as he snapped at buttons, running through his preflight check.

"Yes," Ryan and I said simultaneously.

With a faint shudder, the glider disconnected and began to fall toward Purgatorio.

"Intergalactic diplomacy, here we come!" Tarkos yelped.

The Greete were expecting us. They had accepted our call for trade negotiations and understood our offer. I didn't know if we would be able to make a deal. I didn't know if I had done the right thing. But it was done now, and I would do everything in my power to try to set up the symbiotic relationship—our carbon dioxide for their oxygen—that would let us mine matryoshk for a year.

And then we would return to Earth, where I would stand trial. I had one defense: I did what I believed I had to do. I clung to the thin hope that someone on the jury would agree.

A series of metallic clangs sounded against the glider as it dropped: the remora probes were leaving the ship and latching on to us.

"Bloody Galactic snoops," Ryan muttered.

I gave her my toothless smile. "The humans are finally doing something interesting." ■

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On the Evolution of God

Robert Lundy

All major species, through the years
That measure out their long careers
Have little concept of the flow
Of geologic time, and so
Believe their world lately started,
Can't conceive themselves departed,
Think they've lots of time to spend,
Believe their world is without end.

In the Cambrian explosion in all areas and spots,
Things the Earth had never seen before appeared in carload lots.
If dominating life forms show the image of Almighty God,
Their Intelligent Designer must have looked quite like an arthropod.

The Permian was an epoch great, the denizens of which
Were dominated by therapsids, creatures who without a stitch
Of clothing on persisted for millennia convinced that they
Resembled their top deity in each and every single way.

The creatures that we know today from movies like *Jurassic Park*
Most likely were enlightened and enraptured by a kindred spark.
Their Voice of God was rather loud and came out sounding very roarish,
And emanated from a pair of jaws that looked Tyrannosaurish.

It therefore should not cause surprise and oughtn't make a skeptic gape
To note that in the present day Almighty God's a Naked Ape,
Or that some think the universe's age is but six thousand years
And that the promise of eternity will settle all our fears.

When man or nature heeds its urges
And from this world our species purges
Then cats and mice and worms and krill
Will fight until one owns the hill.
Then dominance of Sea and Sod,
Will grant them leave to picture God.
His image slowly will come clearer
Until they're looking in a mirror.

Extinction, then, will come along
To silence our successor's song.
For as Lord Keynes once rightly said,
"In the long term, we're all dead."

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THE RETURN OF THE WARLOCK'S WHEEL

Any boy standing atop a cliff feels an irresistible urge to see how far he can throw a rock from it. When I lived in New Mexico, a land richly endowed with cliffs, I indulged that urge myself many times.

When I threw those rocks, I wondered about just what angle I should be throwing them at to maximize the distance they'd go. If you're on a flat plane, the launch angle that will maximize distance is 45 degrees (neglecting air resistance). At a steeper angle, the rock goes higher, but it lands closer to you. At a shallower angle, it simply hits the ground sooner.

"What *is* that optimum angle when you're throwing a rock from a cliff?" I wondered. I assumed the angle only depended upon how high the cliff is. I set up the problem with the appropriate equations, and tried to solve for the optimum angle in terms of the cliff height. I found an equation all right, but I was confused as to what it meant. But in those days I was in charge of the high school computer lab, so I programmed three Apples to chew over the equation and spit out optimum launch angles for assorted height values, and left them running all night.

The next morning I pored over the data and was surprised to find that the optimum angle depended upon more variables than just the height. As noted, on a flat plain you throw your rock at a 45-degree angle to maximize the distance it will travel downrange. To calculate how far that distance is, you need to know how fast the rock will be going when it leaves your hand and the local value of g (g being the acceleration due to gravity). Plug those values into the equations with a launch angle equal to 45 degrees and out pops the distance. The thing to note is that throwing the rock at 45 degrees is going to maximize the distance and it doesn't matter how fast you throw the rock, nor whether you throw it on the Moon, Mars, or Mesklin.

But when throwing a rock off a cliff, that distance-maximizing angle not only depends upon how high the cliff is, but now also depends upon how fast you throw it and what the local value of g is. Now it *does* matter what planet you're on!

By the time I went to teach my classes that day, I fully understood what the equation I'd found had been trying to tell me. More importantly, I learned the value of seeking out *all* of the interlocked variables that might be relevant.

Learning that lesson came in handy ten years later when I was trying to figure out the Marinov Motor. I discussed my work on that thing back in a two-part Alternate View, "The Marinov Motor & Me" which appeared in the February 1999 and April 1999 issues respectively. Around the time those articles saw print I also began working for *Infinite Energy* magazine, continuing my study of the motor and making my mark in the world of weird science.

Weird (or alternate) science has several "holy grails," among them gravity control, limitless free energy, a faster-than-light drive, and the "unidirectional" or

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"reactionless" drive. My Marinov Motor research had led me to the conclusion that, though a unidirectional space drive was out of my reach, maybe a unidirectional motor was not. That is to say, if the net push of the stator on the rotor made the shaft rotate, say, counterclockwise, and the net push of the rotor on the stator was *also* in the CCW direction, then I should be able to hang the thing from the ceiling on a monofilament line and have the whole unit accelerate in the CCW sense with no mechanical part of it rotating in the other direction.

So why did I think I could do this? I came to believe that the Marinov Motor, and my own version called "The Warlock's Wheel," was just a variant of several other odd motors already known to work. The first is the simplest of the unipolar motors, the one-piece Faraday motor. Take a conductive cylindrical rod magnet, arrange things so that it can freely rotate on its N-S axis, put one brush in contact with the outside surface and another in contact near the axis, and it will rotate. The question is: "What is the magnet pushing on to make it rotate?" Some think the magnet pushes on the external circuit. Most believe the magnet reacts with the current flowing through its interior, essentially pushing on itself. Weird, huh?

Another odd motor is the Feynman carousel, discussed in section 17-4 and at the end of section 27-11 of volume II of *The Feynman Lectures on Physics*. Mixing straight quotes from section 17-4 in with my own descriptive modifications, consider a thin plastic disc supported on a concentric shaft with excellent bearings, able to rotate freely. On the disc is a superconducting coil of wire in the form of a short solenoid concentric with the axis of rotation, in which current is flowing. Near the edge of the disc, spaced uniformly about its circumference, are a number of small metal spheres insulated from each other and from the solenoid by the material of the disc. Each sphere is given an identical electrostatic charge. Everything is stationary; the disc is at rest.

Initially, the angular momentum of this motor is zero, right?

Allow the temperature of the solenoid to rise above the critical point until it is no longer a superconductor. While the current was flowing, there was a magnetic flux through the solenoid more or less parallel to the axis of the disc. Now with the current flow interrupted, the flux must go to zero, and an electric field is induced which will circulate around in circles centered on the axis. This field exerts a force on the charged spheres, tangential to the perimeter of the disk, and all in the same sense. This results in a net torque on the disk and it starts rotating. Since no one pushed the carousel to set it spinning, we conclude that angular momentum now apparent was stored in the magnetic field.

That's pretty cool if you think about it. Suppose you started current flowing in the solenoid somewhere else, and only later inserted it into the plastic disc with the charged spheres. Angular momentum stored in a magnetic field is just as portable and real as it is in a spinning gyroscope.

The Warlock's Wheel is also simple. I describe it better and with a diagram in my April 1999 Alternate View, but I'll briefly describe it here. Take two very strong rectangular cross-section neodymium-iron-boron (NIB) rod magnets and put them side-by-side so that the north pole of one adjoins with the south pole of the other, top and bottom. (If you're using the right magnets, they'll do this all by themselves once you bring them near each other, so watch out!) Put this magnet pair on an axle oriented vertically so that it's free to rotate on its long axis. Around the pair suspend a copper ring, inner diameter twice the width of the magnet pair, outer diameter half an inch more, coaxial with the magnets and centered horizontally between the top and bottom. The magnets

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and the ring are free to rotate independently of each other.

To demonstrate the peculiarity of the motor, start with the unit at rest. The brush contact points on the left and right sides of the exterior ring rim are collinear with the axis and the center points of the magnets. When current is introduced through the brushes, it enters on one side of the ring, splits in two, and rejoins and exits on the other side. The magnet pair will begin to rotate in one direction, and the ring will begin rotating in the opposite sense. Now reset the motor to the initial state, but make the brushes touch the ring on the interior rim. Turn on the current and both the magnet pair and the ring will begin to rotate in the *same* direction.

The first time I did this experiment I was so shocked I just went outside and cut the grass. At the time I wrote my two-part article, I didn't understand how the motor worked, but I figured it out later. I concluded my motor was much like Feynman's carousel, only with strong permanent magnets and switchable electric currents.

I became convinced that a unidirectional motor could be built, but what I didn't know was whether I could build one. I did fashion a crude version of such a motor out of NIB magnets and wire wrapped on a six-ounce disposable coffee cup and it *did* seem to exhibit the expected unidirectional behavior. But it was so crude it was hardly ready for a formal presentation and its performance was erratic enough that, had someone else built it, even I would not have found it a convincing demonstration of a unidirectional motor. (I described a souped-up version of this motor in my story "Nova Terra," which appeared in the January/February 2004 *Analog*.)

How to improve it? Since my first attempt had "sorta worked," this told me two things. The first was that I was on the right track; the second, that there must be many ways to make a model that "sorta works." I didn't want to build a dozen more prototypes with no certainty that the next one would work any better than the previous one. I did a great deal of hard thinking about how to make the next version, but I kept finding myself up against that interlocking variables problem.

For instance, with my first model, I found it desirable to replace the ring with a complex winding consisting of ten turns of copper wire. You might think that if ten turns works a little, maybe twenty will do twice as well. But it doesn't work that way. I knew before I built the first one that the fewer windings I could get by with, the better. But when I tried to figure out "What is the ideal number of windings?" I discovered that the question had no simple answer. To answer it, I needed to know how strong the magnets were, what all of the dimensions of the motor were going to be, what the wire diameter would be, how much current was going to flow, what the drag of the brushes on the commutator would be . . . It was the rock thrown from a cliff problem all over again, only worse. A hopeless morass of interlocking variables, and this time I lacked the computer skills to even begin to write a simulation to help me out.

When I left *Infinite Energy* magazine I stopped working on the Warlock's Wheel, but I'm starting to again. I don't expect to make anything practical, although I would like to get a journal article out of the research. Perhaps something suitable for *The Physics Teacher* or even the *American Journal of Physics*. But mostly I'm going to work on it because my son Joshua has begun to show an interest in physics, engineering, and electronics. If you want your child to behave a certain way, at the very least you must model that behavior yourself. I want my son to grow up with memories of his dad doing interesting experiments in a basement lab, and hopefully of helping me, too.

That's a variable I can control. ■

JEFFERY D. KOOISTRA

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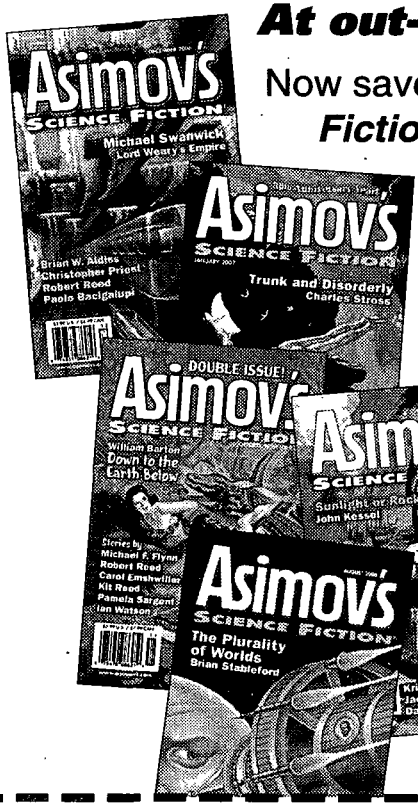

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Back

Susan Forest

Sometimes attention to detail is *really* important. . . .

It was while Alan and Victor were touring the warehouse with the real estate agent that a slip of paper bearing the words, "It worked," materialized on a desk in the office.

Alan stared at the note, strength draining from every muscle in his body as disbelief turned to realization, then to euphoria.

"Alan—" Victor swallowed, turning white as the paper, his eyes wide beneath unruly curls.

Alan lifted the note and fingered its crisp, white softness. It was real. Real.

"We haven't started the experiments yet."

Thirteen years—thirteen goddamn years of hope and faith. And now, Alan's belief in Victor had been borne out.

Victor turned to the real estate agent. "We'll take it."

"This proves it." Words poured from Alan's mouth, out of control, as he paced the room. "It's going to happen, Victor. The world has changed. It has."

"Well, something's happened," Victor conceded. He snapped his laser measure closed and knelt on the concrete floor to record the width of the West Vancouver warehouse in his notebook.

Alan squatted in front of him, next to the wall. "And no one knows it but you and me."

It was pushing ten o'clock, and neither of them had thought to go home. The warehouse was dusty and dark, lit by a half dozen fluorescents high above their heads and the sound of traffic and trains filtered in from beyond the aging brick and lumber walls. The real estate agent, frightened and suspicious—but ten thousand dollars richer—had left with their signed lease hours ago.

Victor pushed his stylus behind his ear. "We still have to build the time machine and send that paper back to today's date. The experiment isn't done until we do."

"But we know the results. The rest is

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just technical."

Victor eyed Alan. "Maybe."

"Maybe?"

"We can still screw up, Alan."

Alan slapped the paper as proof. "Look at it. How can you be so skeptical?"

Victor frowned in annoyance. "Put the paper down before you wear it out. If this turns out to be what we hope, that's a valuable archive you've got your biodegrading sweat on."

Alan hurried to the office, holding the evidence gingerly by one corner and put it in his briefcase, letting his eyes linger on the handwritten scrawl for one last moment. Then he whirled back to Victor, who was on the floor, pointing the laser measure at the ceiling.

"What do you mean, 'maybe'? How could this paper appear out of nowhere, unless *we* sent it back in time?"

"Lots of explanations. Maybe someone's working on a molecular transporter or duplicator. Could have been someone else also working on time travel. There's been sufficient data in the world archive since 2032 for anyone to access." Victor collapsed the laser beam. "We have competitors, you know, Alan."

"Competitors with a paper marked, 'It worked,' in *my* handwriting?"

Victor pulled himself to a sitting position and pushed his long curls away from his glasses. "Alan, you set your heart on things. I don't want you to be disappointed. I don't want you to give me credit for being a genius when so many things can still go wrong. It's possible to want something so badly you miss the obvious, you know."

"The paper appeared out of nowhere in front of our eyes in the very location we leased to do the experiments. I didn't miss that."

"Besides, we don't know how far along other researchers are. We still have a lot of work to do." Victor punched the measurements into his notebook. "And we have no university or grant money or big corporations behind us."

Alan sat cross-legged on the floor. "Because we don't want red tape to tie us up until we're ninety."

Victor shrugged. "Academic backing lends credibility."

"Not always. Corporations and universities have agendas, Victor. The only way to really do this is on our own."

"So you say. But, Alan, have you thought about how much it'll cost before we get results we can publish? Have you really worked it out?"

"You know I have the money."

"Enough?"

"Great-uncle Alan never made a bad investment in his life. There's more than enough."

"But are you sure?" Victor closed his notebook. "There are other things you could do with your inheritance."

"Like what? Lie on a beach somewhere?" Alan snorted. "Would you do that with your life?"

The sound of a freight train slowing as it approached the docks almost drowned Victor's response. "No," he said. He lifted his head. "I wouldn't."

"Listen. The money's mine. I can do with it what I want."

"Whatever you want, sure." Victor crawled over to the wall to inspect an electrical outlet. "But Alan, your great-uncle, or whoever he was, may not have meant investing in time travel."

"Who knows what he meant? I never met him. But his will repeated—" Alan punched the floor with his finger. "Repeated, Victor—that I was to do *anything* I wanted with the money, anything at all, and none of it was to go to any other relatives. Uncle Alan might not have known me, but he had complete faith in me."

"Weird."

"Who cares? We've got the money." Alan leaned his elbows on his knees. "Victor, I've wanted this since I was a kid reading *Weird Tales* with my flashlight in the attic. I wished I'd been the

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first astronaut to set foot on Mars, if that hadn't happened before I turned ten. And even that was a privately funded mission."

"You're not a kid, now. You're thirty-five."

"Yeah. Thirty-five, and what have I done? I want to do something important. Don't you?"

Victor grinned. "Yeah."

"We'll do it and we'll be the first. We'll go down in the history books." He could imagine what it might be like to go back in time. "We'll make the study of antiquity a completely new science, Victor—solve mysteries from the beginning of time. Maybe—I don't know—cure poverty or prevent crime." Alan slumped against the wall and the air puffed from his lungs. He shook his head. "Maybe even see the future. Wouldn't *that* be something?"

"First we've got to finish perfecting travel into the past." Victor picked up his instruments. "Come on. It's late."

"And we will perfect it. In fact—we have."

Victor put his notebook in his pocket. "Say, did you know the real estate agent told me this warehouse has video surveillance tapes that go back to 1958? Do you know how rare that is?"

"That settles it. This was meant to be. Everything's coming together." Alan put a hand on his friend's wrist. "Victor, this machine could be the number one most important invention in the history of mankind. And it's you and me."

Victor smiled at his friend with affection. "Once we've done it."

Alan bit his nails ragged the night before the first experiment. Victor had built a small machine that took up less than a quarter of the warehouse space, and it was ready to be tested.

The day dawned overcast and threatening rain. Outside the warehouse, engines chugged up and down the yards in fine salt mist. Within, Alan hovered over the technicians, holding the note that had materialized out of thin air in a pair of tweezers, while interminable minutes dragged into interminable hours as the technicians double- and triple-checked the calculations.

Then Victor tore a page from his notebook and pulled a pen from his pocket, waving Alan over to the table in the office. The actual time-travel booth was a glass bell jar; every molecule within it—the air as well as the note—would be sent back eighteen months, to the day Victor and Alan had toured the warehouse. A valve on the top of the booth would allow a prespecified amount of air from the room to be sucked into the bell jar as its contents departed.

Alan set his note on the table, and picking up the pen, began to write. But before the ink was dry, the time-travel paper vanished, leaving only the note Alan had just written.

The technicians stared. Victor frowned. Alan felt his mouth go dry.

Then, nodding, Victor took the note from him, put it in the bell jar, and activated the time machine. There was a hum, and the note disappeared, leaving no evidence that it had ever existed. "Of course," Victor said softly.

Alan couldn't believe what he had just witnessed. "It's gone," he whispered. "Our proof . . ."

"No—" Victor shook his head. "No, the theory predicts this. The two notes can't both exist at the same time."

"But—but—did you know the note would vanish?"

Victor considered. "No," he said slowly. "But it makes sense when you think about it. There can't be an anomaly, like a time traveler meeting himself. The disappearance of the time-travel note proves it."

"But you didn't know that would happen."

"That's why we call it an experiment, Alan. We make predictions, but we don't actually *know* what will happen until we try it." Victor's grin spread. "But really, the disappearance of the

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note proves that we were right."

"It does?"

"Yes! Alan, we have just sent the first object larger than an atom back in time." Victor grabbed his shoulders, nodding slowly at first, grinning behind his unkempt beard.

The technicians cheered.

"Really?" The other's rare enthusiasm infected Alan, and he could do nothing but grip his old friend by the arms and pull him close in a heartfelt hug. The celebration that night at the Granville Pub went until three o'clock in the morning.

Victor published, and the race was on.

Working twelve and fourteen hour days, it took seven months to build the equipment for the next experiment. Alan withdrew his inheritance and savings and talked friends into lending money, but the publicity brought investors in droves.

The new time machine had to have a larger booth and Victor had to recalibrate the computers for more complex living biological material. Rather than using a bell jar, he emptied the entire warehouse office and converted it into the new booth. He designed it to both send and receive, because the third stage of the experiments would revolve around bringing subjects back to the present, and with the pressure of competition, Victor didn't want to halt between the second and third stages to build a more complex booth.

The second-stage experiments with flatworms, stray cats, and Alan's potted palm went just as smoothly as the experiments with inanimate objects. Victor and Alan appeared on the cover of *Time* magazine, and Alan quit his position at the chartered accountant's firm to take on the full-time job of managing the publicity, investors, and lawyers.

But the success of time travel in any useful way hung on one question: getting back; the stage three experiments. Flatworms, stray cats, and potted palms were the wrong test subjects to make a return trip.

An air of excitement infused the warehouse as Alan arrived—two hours early, too excited to sleep or to stay away—for the first of the stage three experiments. As always, he tried—unsuccessfully—to stay out of the technicians' way as they worked. It was all he could do when a new technician came in, not to jump up and correct him; he'd seen the procedures so often.

"Alan." Victor stood before him in jeans, T-shirt, and scruffy beard. He looked exhausted and irritable. "It's time."

Alan sprang to his feet and followed Victor to the office/send-and-receive booth. "I'm nervous about this chimp, Victor."

"She'll be fine. She's been training for six months."

"What if she breaks the return switch?"

"It's made of tempered steel."

"I thought she was kind of slow in the last test."

Victor stopped abruptly and turned to face Alan. "She'll have seventy-seven years to pull the switch." He turned on his heel and continued toward the array of generators and computers that filled every square foot of the warehouse.

"But what if she gets distracted and doesn't pull the switch? I don't think chimps are reliable test animals."

Several folding chairs had been set up, but the few VIPs they had invited—the president of Simon Fraser, his physics department head, visiting experts from Moscow, Berlin, and Seattle, a select handful of science reporters—were too excited to sit. Alan shook hands perfunctorily and followed Victor to the main console.

Victor turned and whispered sharply, "We've specifically designed the return mechanism to be chimp-friendly. Listen, Alan. I know you have a lot riding on this experiment, but sometimes you get in the way. Just back off a little. I know

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what I'm doing."

The barb stung. Of course, Victor was just touchy. He was under a lot of pressure to succeed. Alan'd wanted to bring in the big guns today—major world media—but of course, that was premature. He needed to give his partner space.

Victor summoned the animal handler. "Chimps are ideal for this type of work," he said pointedly, ostensibly addressing the visiting experts as the handler took the chimp from her cage. "They're trainable and reliable."

"She's going back to the early sixties," Alan told the visitors, feeling a little subdued. He had to support Victor.

"We're sending her back seventy-seven years to 1962. We chose that gap because it's longer than the chimpanzees' lifespan," Victor said.

"Yes. In case anything goes wrong, she can live out her normal life. We don't want animal rights groups complaining about our experimental procedures. Although, one could assume that dying by becoming nonexistent would be preferable to many ways a chimp could die." Alan cringed at his own words as they came out of his mouth. It wasn't good PR to talk about the experiment failing and the animals dying.

But the semicircle of sages murmured in agreement. The trainer strapped the chimp onto a recliner just inside the office/booth. The switch that activated the banks of computers arrayed in the warehouse had been mounted to the wall of the office, easily within the chimp's reach.

"We have a photograph from May twelfth, 1962," Victor said, salvaging their audience, "showing this whole warehouse to be empty."

"Except for the cigarette package," the Russian added.

Alan was impressed—and a little frightened—that a potential competitor knew this level of detail about their work. "Right. Exactly." He'd searched for months to find security footage of the warehouse office, showing some proof that the chimp would be able to bring back to the present.

The trainer closed the door to the converted office. "Ready." Alan could see the chimp, small on the full-sized recliner, through the office windows.

"The chimp'll appear in the warehouse office twelve hours after the time of this photograph," Victor said. "At 2:01 AM when, we expect, no one will be there to witness her arrival." A prompter, which would cue the chimp to release herself from the harness, open the office door, find the cigarette package, come back to the booth, fasten the harness, and flip the switch on the wall of the office to return to the present, was strapped to her wrist.

A hush fell on the assembly. At ten o'clock, Victor nodded to the animal trainer, who signaled the chimp. The chimp reached over to the wall and pulled the switch—and disappeared.

The prompter remained in the recliner.

The assemblage stilled at the implication. Victor looked at the technician. The technician shook his head, mystified.

Alan gripped his face in frustration. He knew it!

"Hold on," Victor said. "The chimp has been trained. The prompter was only a backup."

The Russian raised her eyebrows.

"The return time is preset for two minutes after ten o'clock," Victor said. "Let's just see what happens."

They watched the digital numbers on the time machine flicker through milliseconds, punctuated by the rhythmical tick of seconds.

"We expect the cigarette package to have a traceable lot number or excise tax stamp, or that the paper can be analyzed for composition compatible with the manufacturing processes of the early sixties." Victor's words, though quiet, echoed through the room, an irritating attempt to make everything seem normal.

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The clock clicked 10:02—

—and the milliseconds ran on.

The technicians watched the clock in stunned surprise.

Tick.

An entire second late.

The Russian shifted her feet. Eyes flicked from the clock to the office to the technicians. To Victor.

A minute passed.

A technician checked settings and read-outs. The assemblage waited, silent. The hum of electronic machinery, the occasional shuffle of a shoe on concrete magnified the moment. The animal trainer scraped the chimp's cage against a wall. Victor stared at the console, his face pale.

When a technician offered to go for coffee, Alan realized their investment, their fame and their future had vanished as irrevocably as the chimp.

After the third chimp went missing, the last of the investors pulled out.

"At least we still have the equipment," Victor said the day Alan told him they had to put everything into storage. The money was gone, and Alan couldn't justify rental on a space that wasn't being used. "Maybe the chimps lived out their lives naturally."

Alan shrugged. Maybe. He had other things to worry about. "Sure you don't just want to sell everything?"

"You know, the surveillance video from May third didn't show the cigarette package on the floor." Victor turned the key in the warehouse door. "I think one of the chimps must have done what it was trained to do, and picked it up."

Alan pulled his collar up against the wind and stuffed his hands into empty pockets. He didn't want to get back into a debate with Victor about what went wrong. He knew what went wrong. The chimps didn't pull the switch to return. Alan had tried to smooth things over, saying that this was why they did the experiments: to see what happened, to iron out the glitches.

In hindsight, of course, they couldn't expect the prompter to go back in time with the chimp; the time machine had been recalibrated for complex living organic material. In hindsight, scientists understood why the Mars Climate Orbiter crashed in 1998, too. Alan had laughed when he heard that a NASA subcontractor had used imperial units instead of the specified metric units. So simple. So many experts involved. But hindsight was irrelevant. The mission had failed, and Alan wasn't laughing now. So had their time-travel experiments.

But the loss of money and the failure of the three experiments wasn't the worst of it. Every publication from *Science* to *Star On Line* had denounced Alan and Victor as frauds. The reporters, the experts, even the technicians who tried to be loyal had to admit they had seen the chimps disappear. But was that time travel? None of them had been in the warehouse in 1962 to see the chimps reappear. Tabloid reporters went back to the real estate agent who was present when the first paper appeared, and she claimed not to have seen it actually happen, that Alan could have pulled the paper from his pocket when she wasn't looking. Even the verified experiments with the potted palms came into question.

Now, colleagues who once stood in groups around Victor at conventions looked the other way as he approached. Alan's picture was on the cover of the *National Inquirer.* The scandal was bigger than cold fusion, the Stanford prison experiment, and Piltdown man put together. They were laughing stocks. They would never be taken seriously again.

"Want to go somewhere for a drink?" Alan asked.

Victor looked down the street toward the train yard. A dust devil tormented a newspaper out of the alley and plastered it against a power pole. "Nah."

Alan turned his back on the wind. His bequest was gone, the accounting firm

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thought he was a flake and Janice had walked out four months ago, saying she couldn't go on living the life of an impoverished widow while he spent all his time with Victor. Tomorrow he had to begin bankruptcy proceedings before the investors descended to claim everything he owned.

They'd been so close to doing something of significance. Changing man's understanding of the universe. Time travel was real. It existed. And he and Victor had almost proved it. Maybe someone would do it, build on their work, but it wouldn't be them.

Alan still lay awake nights replaying what went wrong. What they could have done. The disappointment was so bitter he could feel it in his mouth. And for what? Chimps that wouldn't pull a goddamn switch!

And Victor. Like Alan, he'd wrapped himself in the project for so long, to the exclusion of friends, family, love life—Alan wasn't sure what Victor would do. The two of them were a real pair.

"Alan."

He turned back to his friend.

"I'm sorry. About the money."

"Hey." Alan punched him playfully on the arm. "We knew it was a long shot. And anyway, wasn't this really about bettering society? What an impact we could've had, eh?"

"I really feel bad. Your whole inheritance."

"I could've said no."

Victor kicked a can down the street.

"It's just so damn frustrating," Alan said. "We were this close. *This* close!"

"I know."

"Victor, I really think chimps were the wrong animals. They just didn't pull the switch to return."

"It wasn't the chimps."

"How do you know? They're not as smart as everyone says."

"Listen, Alan, I'll tell you what. We'll figure this thing out, yet."

"I've figured it out—"

"The universities that were courting us have disassociated themselves, but there's a small college in Alabama that's still offering me a position. I'm going to work out what went wrong with the return apparatus. I promise."

What?

"There's no money. Just my salary and what I can scrape together in research grants to do the work. But some day, Alan. Some day. You and I will be back."

"You're going to Alabama?"

"Yeah. I leave Monday."

"You're moving to the States?"

"Yeah."

"You're leaving."

"Yeah." Victor put the keys to the warehouse in his hands. "You know, I've been combing the webnet, looking for anything that could give us a clue. There was an article from May of '62 in the *Vancouver Sun* about chimps that escaped from a private zoo. I was thinking, maybe they were our chimps. You know? Maybe our chimps got there fine—they just couldn't get back to us."

Victor was carrying on with the project.

He'd bled Alan dry and now he was using the results, *their* results, to rebuild his name in academia. Alan felt the blood rising in his throat. "When were you going to tell me?"

"Tell you what?"

"Tell me what? That you're taking this project away from me!"

"Taking—whoa, now. You're the one that pulled the plug, Alan."

"Yeah, once the money was gone. How much longer did you think I'd be able to keep financing your private little scheme?"

Victor blinked. "You offered! You got the investors! You—"

"Time travel's no good if you can't get back!" Alan punched every word in an attempt to get the idea through the blockhead's skull.

"Hey, I proved—*proved*—that time travel works, Alan. Who has ever done that? Nobody! Getting back—getting back, that's just a technical glitch, a puz-

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zle to work out—."

"A technical glitch that put me into bankruptcy!"

"You'll get your money, if it's so goddamn important."

"Yeah? Well, a livelihood, yeah, that's important. Food on the table. I've been excommunicated from my family for bilking them all out of their life's savings. But you know what is the worst part? That you don't believe me when I tell you I know what the problem is. It's those goddamn chimps!"

"It's not the chimps, Alan. Listen, you'll get your money. I'll work out the problems. We'll set up the corporation, just like we planned."

"Yeah?"

"Yeah."

"And once you have the answers, what's to stop you from putting it together with some big German investor, or Japanese, or some entrepreneur you meet in the States?"

"Alan, what are you talking about? You—"

"I have no money. I have debts. I can't back you. I can't invest in this scheme."

"Well, wherever we get the money, we're in this together."

"Hah."

"Alan."

"Hah." He stomped down the street.

The traitor! He was getting off too easy. Alan turned and came back.

He jabbed Victor in the chest with a finger. "*You're* going to find out why those monkeys couldn't get back?"

"Chimps."

The word felt like a detonator on dynamite. Alan's fist exploded on Victor's face. Victor crumpled to the sidewalk on his backside, blood spouting from his nose.

Alan shook the sting from his fist.

Victor looked stupidly down at his bloody shirt.

Alan took a step toward him, then got himself under control—barely—and stomped back to his car. He opened the door. "You?" he shouted back.

Victor pulled himself to a sitting position and leaned forward, hands pressing on his nose.

"You go to hell!"

You don't send a chimp to do a man's job.

There was a way to find out how the chimps screwed up. A very simple way. And Alan was goddamn going to prove it.

He returned to the warehouse and powered up the time machine. The target time still read 2:05 AM, the arrival time for the third chimp, so he reset it for 2:07 AM. He had seen the operation—participated, even—and asked so many questions over the years, he had no trouble operating it. He double-checked the settings, just as the technicians had done each time they ran a test.

The warehouse was quiet but for the hum of the generators, dim but for the single light Alan used to finalize his preparations. He stepped into the office that had been converted into a time-travel booth. He sat in the recliner and flipped the switch on the wall.

The experience of traveling back in time surprised him. He was simply there. He fell onto the floor because there was now no recliner in the office. There was a shock of displaced air molecules against his skin; his clothes were gone. Nausea touched his stomach momentarily.

He breathed and blew out sharply.

The time-travel booth was now an office, with a desk and swivel chair, neither of which were occupying the space he had materialized into, thank God.

Through the window that looked out onto the warehouse floor, he saw no time-travel computers or machinery; only three chimps fighting over a cigarette package.

God. It worked.

"Yeah!" he cried aloud and pulled open the office door. The chimps scattered, then turned to look at him. "Hey!" he yelled, and they ran in all di-

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rections. "We did it! Hey, chimps, we did it! It works!" He spun in a circle. "Victor!" he yelled. "We did it! You did it, you bastard!"

Whatever the problem was, it didn't exist now.

He had to tell Victor.

First, though, he needed proof that he'd been here. He picked up the cigarette pack the chimps had dropped and flipped it over. BD02613 was stamped on the bottom. "Yes!"

He flung open the door to the office to pull the switch to return to the preset time.

He stopped short. He would never laugh about the Mars Climate Orbiter again.

There was no switch.

And in 2004, on his seventy-seventh birthday, his affairs in order, contentment in his heart and his wife at his side, Alan vanished. ■

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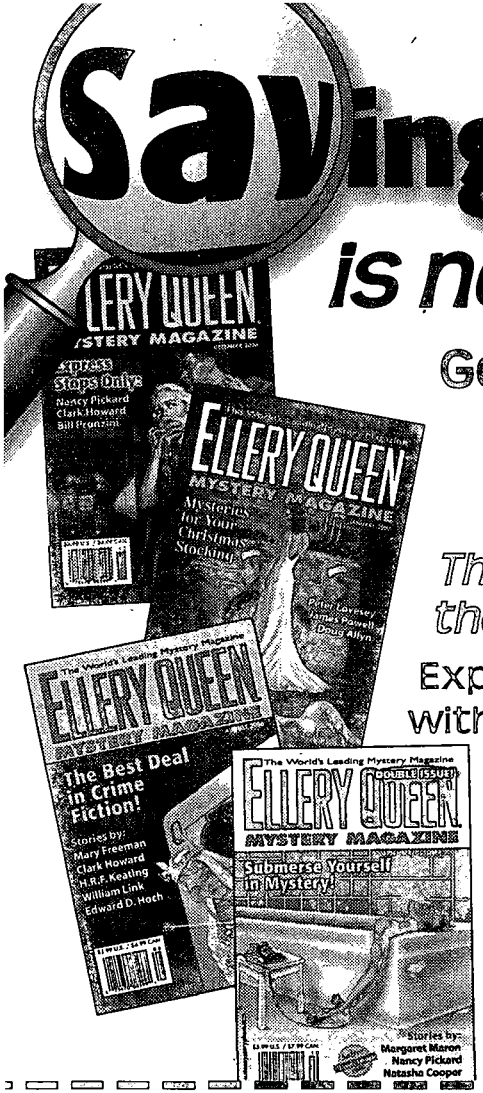

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Finalizing History

Richard K. Lyon

Is anything ever *really* final?

1

The only people who know our phone number in Maine also know to call here only in an emergency. Anxiously grabbing the phone, I heard someone say, "Hello, this is John W. Campbell. I'm calling on a matter of extreme importance for Earl Stanley Gardner. I'm the editor of *Analog Science—*"

"I know who you are, Mr. Campbell," I said, "but why are you calling me? I haven't written science fiction since 1932."

Before Campbell could reply, someone who must have been standing beside him said, in a thick Hungarian accent, "Tell him that the fate of the world is at stake!"

"Who said that?" I demanded.

"That was Edward Teller," Campbell explained. "He's right, though it's not that dire. The world isn't coming to an end or anything like that. It's just that there's a decision of great historic importance hanging in the balance. Please, could you tell me something? I know this is a strange question, but am I correct in assuming that you haven't taken a nap today?"

"I haven't. What's that got to do with anything?" I demanded.

"We'll explain when we get to your house," Campbell said, his voice brittle as if he were under stress. It sounded as if there were several people standing around him, all trying to tell him things at once. Was one of them really Edward Teller? Campbell must have gestured all of them to silence, because the background sounds quieted and he continued, "We'll be driving from my house in New Jersey, so it'll be several hours before we can reach you. Please, Mr. Gardner, don't go to sleep in the meantime. I can't explain, but I give you my word that it's a matter of the utmost importance. We must talk to you before you sleep."

"Just who is this 'we' you're talking about?" I asked. When he told me, I stared at the phone in astonishment. Something big and very strange was going on. Out of habit, I gave him directions, while I tried to understand the

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mystery that had just confronted me.

I'd hung up the phone before I noticed that my wife Agnes was staring at me angrily. "Earl," she said firmly, "you know we absolutely cannot have visitors. It's not just that the house is a mess. You've got that horrid old outhouse in the backyard! The thing's an eyesore! Why, anyone who saw it—"

Agnes went on at some length. Strictly speaking, the outhouse might not qualify as a historic building, but it did date from before the Revolutionary War. Agnes's attitude toward the outhouse had changed when I married her. For several decades as my secretary, the perfect Della Street to my imperfect Perry Mason, she'd never said anything about the outhouse. As my wife, however, she saw a few things differently.

Switching gears, she stopped telling me why it was impossible for us to have visitors here in Maine the way we did at our New York apartment. Instead she demanded, "Who's coming and when will they get here?"

It would have been nice if I could have told her that our coming visitors weren't anyone of any importance. Instead I had to say, "Well, there's John Campbell, he's the editor of *Analog Science Fiction* magazine, Robert Heinlein, he used to write for Campbell, and, ahh, Edward Teller—"

"The father of the hydrogen bomb?" she demanded.

"Yes," I admitted, "he's the one who said the fate of the world depends on my not going to sleep until they get here. There's also that actor, Ronald Reagan. He was president of the Screen Actors Guild, and, ahh—" I hesitated, fearing how my wife would react. Since there wasn't any way around it, I said, "Jackie Kennedy, the wife of the President Elect."

"That's the group?" my wife wanted to know.

"That's who Campbell had at his house in New Jersey," I explained. "They'll be driving through New York City to pick up General Douglas MacArthur."

She started laughing. "Earl," she said when she regained control, "This Campbell fellow told you all that, and you actually believed him!"

"But Campbell's a serious professional editor," I objected. "He wouldn't play a silly practical joke."

"He's the editor who published that Dianetics garbage," she reminded me. "What he told you is obviously nonsense. In the first place, the Secret Service would never let the wife of the President Elect just drive up here, and she'd never come with Ronald Reagan. He's a Democrat, but he campaigned for Nixon."

Since logic was on her side, I didn't argue. The sensible thing for us to do was to ignore Campbell's absurd request. If he hadn't called, we'd have spent today putting the last touches on a Perry Mason novel. Normally that was something we could finish in time for dinner and a good night's sleep.

This time, however, we were in a mess. Thanks to scheduling problems, I had to send my publishers a finished manuscript tomorrow morning. While that's not usually a problem, I work with a group of volunteers in my "Court of Last Resort." Over the years, we've secured the release of several men unjustly convicted of crimes they didn't commit. Yesterday, however, they'd told me about a case that was very similar to the novel I'd just written. The big difference was that the man in jail was most likely innocent, while the corresponding character in my novel was guilty.

Published as was, my novel could make it a great deal harder to get the innocent man a new trial. Since many of the similarities between the real and fictional cases were purely cosmetic, the obvious cure was to change the novel. That, unfortunately, would be a long job.

Della Street never did better by Perry Mason than Agnes did by me tonight. With endless patience but always de-

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manding that I do my best, she worked with me, until, in the small hours of the morning, the novel was finished.

That was when a long black limousine pulled into our driveway. As its doors opened and men in black suits poured out, a second and a third limo entered our driveway and waited some distance from our house.

One of the men from the first limo knocked on our door. Opening the door I found myself facing a man whose well-fitting suit didn't quite conceal the gun he wore in a shoulder holster. "Mr. and Mrs. Gardner, I'm Special Agent Carr. I hope you don't mind if we look around before Mrs. Kennedy comes in."

"Sure," I said, but he was looking at my wife. She had an expression on her face, the one she wears when she's about to get into a bargaining contest with a Maine merchant.

"Of course," she said, smiling, "you need to make sure everything is safe for the new First Lady, and I need to get my house in order for her visit. You'll find the vacuum cleaner in the closet over there."

In a few minutes, our house was spic and span. When I couldn't understand why the Secret Service was being so obliging, Agnes told me, "Mrs. Kennedy coming here on a fool's errand and they know it. They want to spare us any embarrassment, so we'll do likewise for her."

My wife even got them to park their chase limo so it hid the outhouse.

2

Having arrived in the first limo, John Campbell walked toward my house well before the cleanup was done. A solidly built man with an angular face, horn-rim glasses and buzz cut brown hair, he paused on my doorstep to discard a cigarette butt. While my wife's judgment of him seemed a little harsh to me, he did have a history of courting controversy. In principle that was a good thing. Unorthodox ideas deserve a fair hearing. My Court of Last Resort, however, depended on my credibility. I needed to avoid being involved in anything too controversial.

Despite my misgivings I stepped out of the house into the moonlit night and walked toward him. "Mr. Gardner," he said, speaking rapidly, "I know you want a sensible reasonable explanation, but all I can tell you are the facts. Two nights ago I had what, for want of a better word, I'll call a dream."

Pausing to light a cigarette and give me one, he continued, "In this dream, I was one of nine human beings summoned to serve on an advisory committee. The summons came from an extraterrestrial, an incredibly powerful being capable of voyaging between the stars and traveling through time. What it wanted from us was a unanimous recommendation regarding a decision that would greatly impact the course of human history."

When Campbell paused, I didn't say anything. Part of being a good interviewer is knowing when being silent will prod the other guy to say more.

In a moment Campbell continued, "When I woke up, my memories of this strange dream were sharp and clear, unlike any dream I've ever had before. Thinking it might be useful story material, I wrote down a very detailed account of the dream. Later that day, I had a phone conversation with Robert Heinlein. Three nights before he'd had the identical dream—no—I mean he'd had the exactly corresponding dream. In my dream we'd been sitting at a conference table with him two chairs down on my right. In his I'd been two chairs up on the left. One of the other seven people was a woman neither of us recognized and we were in perfect agreement on the identity of the other six.

"We also came up with identical seating arrangements. Since that could not be coincidence, Robert and I started calling people. We began with the writers. While I had a problem getting your

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number up here, we did reach Clifford Simak. He's a newspaper editor who writes science fiction. He was absolutely fascinated by our story and was very polite, but he hadn't had the dream and I'm not sure he believed us.

"We almost dropped the whole thing, but I had a friend who gave us Ronald Reagan's number. It turned out he'd had the dream, and he could give us the numbers for Edward Teller and General MacArthur. They'd both had the dream, and MacArthur had Jackie Kennedy's phone number.

"It wasn't until we talked with her that it hit us. None of us had had the dream on the same night as any of the others, and the nights we dreamed corresponded to where we sat around that alien's conference table. That meant Clifford Simak would have the dream last night, and you'd have it tonight.

"The problem was that Clifford's taking a vacation in Hawaii, and he'd already gone to bed by the time we called his hotel. All we could do was leave a message for him to call us in the morning.

"When Cliff finally called, he gave us a detailed description of a meeting with an extraterrestrial. None of us had told him any of the details of our dreams, but his account exactly matched the dreams we'd had. We—"

He stopped because the second limo was approaching the house. The rest of my guests were arriving, and it was time for me to play host.

3

After welcoming our strange collection of guests into our home, my wife began serving coffee, starting, of course, with Mrs. Kennedy. Wearing a stylish black French dress, she sat on a sofa with Campbell on her left and Robert Heinlein on her right. He and MacArthur both sat ramrod straight, their heritage from the U.S. Naval Academy and West Point, but Heinlein still showed signs of the illness that had ended his military career, and the General showed the weight of his years. Not to be outdone, movie star handsome Ronald Reagan sat as straight and tall as if he were in the saddle for a western. Nobel Prize winning Hungarian physicist Edward Teller completed the group.

Once everyone was comfortably seated and had coffee, my wife explained that this had been a very long day for her, and, if no one minded, she'd go to bed now. I had to keep from smiling as she departed. Tired as she must be, she was not going to bed. Instead she was going to sneak out and talk to the Secret Service agents. Many times in our decades together, I've had an interview with some very important man, while she'd gotten the truth by talking to his support people.

Campbell had told me an incredible story, and now all these people were confirming it. Did that make it true or were several highly respectable people lying? General MacArthur, Edward Teller, and Robert Heinlein were all right-wing republicans and avid anti-communists. Though Ronald Reagan was nominally a Democrat, he was also an avid anti-communist.

Could this whole thing be a vast right-wing conspiracy? A plot to embarrass the young President Kennedy before he even took office?

Maybe, but I didn't think so. I've had a lot of practice spotting liars. Sometimes a skillful liar can fool me, but not often. When this many people all told me the same story without a single false note, I was sure they believed what they were telling me. Of course, that didn't make it true, but how else could I explain it?

The round robin confirmation of Campbell's story finished with Edward Teller. His bulbous nose twitching, his watery gray eyes half hidden under eyebrows that were as bushy and black as wooly caterpillars, he asked, "And now, would you like me to provide a logical scientific explanation of these strange events?"

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When I nodded, he continued, "Good, but remember a logical scientific—"

"Please, Dr. Teller," Mrs. Kennedy interrupted, "We don't have time for this. My husband is in danger!"

"Yes," MacArthur said with a small courtly bow to the troubled but elegant lady, "We are all in danger. Even you, Mr. Gardner. All of us were at a meeting with an alien who had the power to revise human history, and who, acting on our advice, used that power. The world we left to go to that meeting was different from the world we came back to. We changed history, and that means we changed ourselves. We let Fate throw the dice again, risking that every chance event in our lives which had gone one way could go another.

"If the dice had fallen differently, you, Mr. Gardner, might have continued a legal career you found boring. Mrs. Kennedy's husband might have drowned when his PT boat sank, and she never met him. A host of other bad things might have happened to any, or all, of us, but they didn't. In our different ways we are all quite successful people."

"But I don't see any danger in that," I objected.

MacArthur waved his corncob pipe toward Robert Heinlein, who leaned forward and said, "The danger is that the dice will roll again. That puts everything we have, everything we are, at risk. It can all be lost at our meeting with the alien."

"But that meeting's over and done," I objected. "It's in the past."

"No," he corrected, "it's in our past, but it's in your future."

Before that strange idea could soak in, Mrs. Kennedy looked me straight in the eye and said, "Mr. Gardner, I've read several of your Perry Mason novels. I know that you're a very intelligent man when you're sitting behind a typewriter on a desk. What I need to know is how you were as a lawyer in court. Were you brilliant? Were you Perry Mason?"

"No!" I protested. "That's why I quit law in favor of writing."

A smile passed between Heinlein and MacArthur, as though they'd just been proved right about something.

Looking slightly unhappy, Mrs. Kennedy, making her voice soft and gentle, told me, "That's a problem. At the meeting you were quite brilliant. In fact, you were so clever that General MacArthur said someone must have briefed you in advance. I said that was impossible, and Mr. Campbell and Mr. Heinlein both snapped their fingers, shouted that this was the Red Queen's race, and that we had to run as fast as we could to stay where we were."

Everyone was looking at me expectantly. They were all hoping that I'd get what they were saying without further explanation.

It took a moment, but I did. A meeting at which the fate of the world was at issue had come to a favorable conclusion because I'd been well briefed. Since they were the only ones who could give me that briefing, they'd rushed here to do it.

As soon as I agreed to let them brief me for the coming meeting, they started taking turns doing just that. MacArthur lectured me on the appropriate way for an army officer to conduct himself with a foreign dignitary while Mrs. Kennedy urged me to laugh at the alien's jokes even if they weren't funny. Ronald Reagan wanted me to become Perry Mason. To help me do that he tried to teach me the tricks an actor used to get into character. On top of all this, Campbell and Heinlein tried to give me a crash course in world history.

Things were happening this way because these people had traveled here in three cars and hadn't had a chance to agree on what I should be told. To make matters worse, Teller abruptly realized that the coffee we'd been drinking was Sanka. MacArthur's solution to this problem was to shout, "Wake up, soldier!"

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whenever he saw I was in danger of nodding off.

At first this worked, but my eyelids were getting heavier. When Edward Teller suddenly said that he thought he understood the quantum mechanics of time travel, I tried to listen, but whatever he said was lost in the gray fog into which I sank.

4

Blinking my eyes, I had a blank moment. I knew I was Earl Stanley Gardner, but who was that? Was I a writer of detective stories?

No. I'd written two closets full of detective stories, but no one would publish them. By profession I was a professor in a law school, and this was another of those necessary but horribly boring faculty meetings

Though maybe this one would be a little different. We were all sitting in a line along a conference table that didn't have any legs or any other visible means of support. The person to my right was Agnes Bethell, the dean of both the law and graduate schools. At my left were journalism professor Simak (chain-smoking like a reporter on deadline) and physics professor Teller. Beyond them were civil engineering professor Campbell, military science professor MacArthur, and Miss Jacqueline Bouvier, an instructor in French. The last of our group were naval engineering professor Heinlein and theater arts professor Reagan.

I couldn't give my colleagues much attention because of what I could see beyond Professor Reagan. A vast metallic face floated there. In a voice like distant thunder, this impossible being was telling a joke. For a moment I was too startled to listen. When I turned my ears back on, I heard, "So the scientist claimed that the experiment in which he sawed the front legs off bears and sewed on human arms didn't violate the animal rights act because under the second amendment he had the right to arm bears."

Normally I despise puns and make no secret of the fact. Just now though, I had a strong feeling that not laughing would be a very bad idea.

Apparently everyone had that idea because we all laughed quite merrily. When the laughter subsided, the metallic face said, "Good evening, ladies and gentlemen. Now that you are all here, this meeting can proceed. I am Atigon. I summoned you here to serve as an advisory panel. Based on your unanimous recommendation, human history will be finalized."

When that produced a lot of surprised squawks, Atigon said, "While that's a new idea for you, finalizing history is only what you might expect if you thought about things logically.

"In general, time travel is impossible because it can produce paradoxes, closed circles of causality in which the cause becomes the effect, and the effect becomes the cause. Conversely time travel is possible in special cases in which such closed circles cannot occur.

"One of these special cases is that of an alien observer such as myself coming to an isolated planet such as your Earth. As long as I remain slightly outside your reality, a reverse causality cycle cannot occur. Without any danger of a time travel paradox, I can revise your history the way an author rewrites a novel."

"Then you called us here to help you play God!" Jacqueline Bouvier protested. "You want our advice on how to change history!"

"No," the metal face said. "Previous committees did that. That's why your history contains so much good luck—World War II, for example. The Germans would have won a quick and easy victory if it hadn't been for extremely fortunate weather that allowed the British to evacuate their troops from Dunkirk."

Looking very much like a bright schoolboy, Ronald Reagan raised his hand. In a respectful voice, he said,

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"From what you say, I gather that human history, as we know it, is more or less the final, no-further-revisions-needed product. Our history, however, contains many terrible events. The Holocaust. African Slavery. Natural disasters and needless wars. Is it beyond your power to prevent these things or are there reasons why they are necessary?"

With a hint of the smile a teacher would give a bright student, Atigon said, "They are necessary. It is a hard lesson, but one that must be learned: pain is good. It is a needful part of the learning process." Our alien host went on in the same vein at some length. Much of it sounded to me like a mixture of Zen Buddhism and patent law, but Ronald Reagan listened eagerly, taking in every word.

When Atigon finish, Reagan asked, "Then, Master, what is there for us to do?"

"In less than a century, a ship from a nearby star will visit your solar system," Atigon replied. "That will end the isolation of your race and make further improvements in your history impossible. That means your history must be finalized, and—Here you must understand—the Law of the Galaxy is that no good thing is completely free. Having gained great improvements in your history, you must pay a price in pain. You must make a small sacrifice so that what you gained will not be free."

"What kind of sacrifice?" Heinlein asked.

The wall on the other side of the conference table suddenly held a list of names: Adolph Hitler, Guy Fawkes, Christopher Marlowe, King Leonidas of Sparta, William the Silent, Joan of Arc, Florence Nightingale, Isaac Newton, Werner Heisenberg, Thomas Edison, and Bartolomé de las Casas, bishop of Chiapa. "If one of these people dies young, that will pay your debt," Atigon said.

"I have two questions," Simak said, "First, is this list complete? Second, you mentioned our giving you a unanimous recommendation. What happens if we can't all agree?"

"The list is complete with the exception of one name my programming doesn't allow me to process." Atigon replied.

Nodding, Simak said, "When we were telling jokes, you had problems with Professor Heinlein's use of navy language. Is this name you can't give us somehow vulgar?"

"That is correct," Atigon replied. "The answer to your second question is that, under Galactic Law, your race has rights. One of these rights is to reject improvements in your history. If you do not give me a unanimous recommendation, you will be exercising that right.

"Please have your decision ready when I return an hour from now, and please be careful in your selection. There are some individuals on this list who can be removed without undoing the improvements I have made to your history. There are other individuals for whom this is not the case."

With that Atigon vanished.

5

One of the things I hate about faculty meetings is that there's always someone who wants us to make the decision without discussing it. Usually that's someone who has guessed what the decision will be if we think about it and doesn't like that result. This time it was Miss Bouvier. Before anybody said anything, she declared, "Our choice is obvious. Getting rid of Adolph Hitler will prevent the Holocaust!"

"No!" Heinlein snapped. "We can't give Adolph Hitler the chop. His blunders were the reason we won the war! He attacked Russia while he had his hands full fighting England. He sent the German Army into Russia without their winter uniforms because he didn't want the Russians to think the war was going to last that long! Later he got sick and couldn't think clearly and made a host of

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disastrous decisions."

"But without Hitler, World War II might never have happened," she protested.

"Of course it would. After World War I, the German people were furiously angry," Heinlein declared. "It was inevitable that—"

"You can't know that!" she said, but a look from Dean Bethell stopped her from arguing any further.

"Before we proceed further, we need to get the ground rules straight," the dean announced. "We've been told that choosing any name from that list will have painful consequences. Given that, we need to assume a worst case scenario for each of our possible choices." Turning toward Professor MacArthur, she continued, "Douglas, if we eliminate Adolph Hitler, what the worst that could happen?"

After a moment's thought he said, "Without Hitler, Rommel would have far more freedom of action. That would certainly make the war longer and bloodier and, in the worst case, Germany would win."

"What about Guy Fawkes?" she asked the group at large.

"I think that, like Hitler, he's on the list for being a bungler," Campbell said. "Fawkes got himself and all the other plotters hanged because he went ahead with the plan to blow up Parliament even though he knew they'd been warned. Almost certainly someone else would have retreated and attacked another day."

"Thank you," Dean Bethell said, smiling now that she had the meeting under control. "Miss Bouvier, please tell us why removing Marlowe from history would be a great loss."

"Why, because he was the greatest writer in history!" she exclaimed. "If he dies as a young man, it won't just be a disaster to English literature. It'll be a disaster for all literature! Everything based on his work will disappear. Half the bookshelves in all the libraries will be empty. Our children will grow up unable to read anything of any great complexity! The theater will be impoverished. TV will be a vast wasteland!"

"Good," she said. "Professor Campbell, do you see any reasons why Marlowe might still be our best choice?"

After looking at the ceiling for a moment, Campbell said, "It's sometimes necessary to remove a large tree from a forest so the small trees have room to grow. Without Marlowe, all these library bookshelves would have room for the works of other writers. There'd be room in the Elizabethan theater for other playwrights, people like Shakespeare, who wrote some decent plays."

"I agree," Heinlein put in. "There's also the fact that many of the people on the list had children. Removing one of them could cause a domino effect. We don't have that problem with Marlowe because he was gay."

"A good point, but children aren't the only dominos," MacArthur added. "There's a children's game in which one builds a tower of blocks and then tries to take blocks out of the tower's foundation without causing it to collapse. That's what we're doing here, but the tower is Western civilization, and the next three names on that list are essential to keeping it standing.

"King Leonidas and his three hundred Spartans held the pass at Thermopylae against a vast army, perhaps a million men. Delay for an army that size is disaster. Leonidas and his men all died, but they weakened the Persians so greatly that their subsequent defeat was inevitable. That saved Greece and all the Greek learning on which our civilization is built.

"In 1573, the Spanish Army laid siege to the city of Leyden, vowing to kill everyone, even the smallest baby. At that time the Spanish Army was invincible in the sense that no other army could defeat them. William the Silent had vowed to save the city, but for a year Leyden's people starved waiting for

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him to keep his promise. At the end of that year, when all seemed lost, he broke the dykes and attacked with his navy. Not only did he save the city, he set the stage for the subsequent destruction of the Spanish armada.

"Joan of Arc prevented France and England from becoming a single kingdom, which would have been a disaster for England."

"Yes," Dean Bethell agreed. "Joan of Arc is also critical because she inspired Florence Nightingale, and, of course, history without Florence Nightingale would be an unmitigated disaster. She established the modern profession of nursing and saved countless lives. To do that she had to force the world to change the way it thought. She had to pick up mountains of Victorian prudery and use the moral force of her example to cast them into the sea. She invented the pie chart to shame the British Army into spending more on the care of wounded soldiers. In the area of hospital reform she . . ."

During this diatribe, Miss Bouvier kept glancing at me. Obviously she wanted to save Marlowe and was hoping for my help to do so. Well, she might be a demure defendant, but I wasn't Perry Mason.

While the Dean ranted, Teller took long puffs on his pipe. Once she finished, he said, "I don't think there can be any serious question about eliminating Isaac Newton. He's absolutely central to the development of modern science. Heisenberg, on the other hand, might be a good choice. If he hadn't discovered the Uncertainty Principle when he did, someone else soon would have."

"Heisenberg's still alive," Simak protested. "With any of the other choices we're just changing the dates on somebody's tombstone. That's a lot different from putting someone in the grave."

Shaking his head, Teller said, "Given what's at stake here, one life hardly matters."

"Yes," Miss Bouvier agreed. "It's a terrible thing to say, but surely we have to focus on the big picture."

"There's also the fact that Heisenberg was a terrible administrator," Simak persisted. "During World War II, he ran the German atomic bomb program so badly that the OSS cancelled plans to kill him. Getting rid of him would probably mean Hitler's getting the bomb."

"Then what about Thomas Edison?" Miss Bouvier asked. "If he hadn't invented all those electrical devices, wouldn't someone else have done so?"

Finishing lighting a cigarette, Campbell took a puff and said, "Yes, and that someone was Nikola Tesla. He was Edison's rival for the title 'The Wizard of Electricity.' Tesla made a lot of important inventions, but I don't think we'd like what we'd get if we replaced Edison with him."

"Why not?" I asked.

"Tesla spent a great deal of time trying to develop a death ray projector." Campbell replied.

"That's right," Ronald Reagan added. "Back in the '30s, I had a bit part in a movie based on Tesla. He was played by Bela Lugosi."

Miss Bouvier was looking at me, an expression of disappointed hope on her face. While I very much wanted to save Marlowe, it was increasingly apparent that there wasn't any better choice. Without much hope, I asked, "What about this Bartolomé de las Casas, bishop of Chiapa? Do any of us even know who he was?"

After lighting a fresh cigarette with the butt of the one he'd just finished, Simak said, "Yes, the bishop is generally regarded as the father of black slavery. It was at his suggestion that the King of Spain allowed Spaniards in the New World to import slaves from Africa."

"Are you saying that we could pick this man and slavery wouldn't have happened?" Miss Bouvier asked excitedly.

"That would be my guess," Simak said. "The question is whether or not

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that would be a good idea. You see, the Bishop meant well, and he may have been right. At the time Africa was having genocidal tribal wars. The Bishop reasoned that people captured in those wars wouldn't be slaughtered if there was a market at which their captors could sell them. We get rid of slavery, and a great many people die in Africa instead of coming to America as slaves."

"That's a bad trade," Ronald Reagan declared, "and besides, Sammy Davis Jr. is a friend of mine. I can't let him unhappen."

For a moment I felt defeated. Perry Mason always got his clients acquitted, but I'd failed to save Christopher Marlowe for Miss Bouvier. Mason would have solved the riddle of the name Atigon couldn't give us because it was vulgar and—

Actually the answer was obvious. Suddenly smiling, I announce, "The name that wasn't on the list, it's Thomas Crapper, the man responsible for the flush toilet! We can keep all Marlowe's great plays. All we have to give up is . . ."

My voice trailed off as I saw MacArthur shaking his head. "When I first saw the list, I was struck by how short it was," he said. "Why weren't people like Gutenberg on it? The answer, of course, is that while history is full of people who did important things, in nearly every case, somebody else would have done it if they hadn't."

He paused to suck on his corncob pipe and continued, "Thomas Crapper didn't invent the flush toilet. Instead he persuaded people to accept it. My experience, when I was on Patton's staff during the occupation of Japan, is that persuading people of things like that can be extremely difficult. Based on that experience and that fact that Crapper's on the list, I don't believe there's anything inevitable about the flush toilet. If we want to keep Marlowe's plays, we have to give it up."

Unhappily I nodded agreement with MacArthur's analysis, and Miss Bouvier reluctantly agreed. While neither of us liked choosing Marlowe to get the ax, we couldn't claim that any of the other choices were better. The remainder of the hour passed quickly, people talking about a great many inconsequential things. I asked Campbell about the first part of the meeting, which I'd missed. He explained that they'd spent the time explaining the concept of humor to Atigon, who'd proved a remarkably fast learner.

Before I could comment, things changed. Once again we were sitting in a row facing a vast metallic face. In a voice like distant thunder, our host said, "You will give me your recommendations. If all of you are in agreement, the recommendation will be accepted."

He/it began calling the roll, and all the others voted to give up Marlowe. I was last, and when my turn came, I said, "If you don't mind, I'd like to ask some questions first. How will mankind be paying a price in pain, if Marlow dies young? If he never writes any plays, how will we know we've lost anything?"

"A valid question," Atigon said. "I will arrange matters so that Christopher Marlowe writes a few plays and is then killed in a knife fight."

"Next question," I said. "Am I correct in suspecting that your programming requires you to answer all valid questions?"

"Yes."

"Suppose the sequence of events is that Marlowe was only wounded in the knife fight. He was then generally believed to have died, but actually recovered, lived quietly, wrote all of his great works but put them in a trunk where they remain unknown to this day. Would doing all that be within the limits of your powers? Would being without Marlowe's greatest works for some three hundred sixty years be a sufficient price in pain? Could you discreetly deliver the trunk containing Marlowe's works to us? Would you do that?"

"Yes, yes, yes, and no."

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Trying not to smile in premature triumph, I asked "Why not?"

"It would be inconvenient to do all that."

"Does not the Law of the Galaxy also apply to you?" I asked. "You received from mankind one of our most valuable gifts, a sense of humor. If no good thing is completely free, are you not obligated to pay this debt by suffering a little inconvenience?"

Atigon did a slight double-take. For the briefest moment his face looked like that of an adult who's been outsmarted by a child. After that moment, his smile was slightly rueful and just a little unpleasant. "I understand human customs for discreet delivery and shall use them to provide you with the trunk containing all of Christopher Marlow's lost works."

"Then, on those terms I also vote to give up Marlowe," I said, as everything got fuzzy.

6

When I woke up, Heinlein and Campbell were still in my living room, but everyone else was gone. Had my actions altered history so that they never came here?

Never existed?

Guessing my fears, Heinlein smiled and said, "MacArthur's asleep in your guest room. Teller and Reagan are in your office reading. Mrs. Kennedy got angry with all of us and left in her limo. I don't think we'll be invited to the White House for dinner any time soon."

"Why?" I asked. "Did you right-wingers start teasing her?"

"I wouldn't describe what we did that way," Campbell said with a slightly guilty smile. "We helped her see things in a more appropriate light. She thought that you and the rest of us had saved the world from disaster, but without any proof we couldn't get the credit we deserved."

"But that's the truth!" I protested.

"Earl," Heinlein chided me, "we had a meeting with someone most religious people would regard as a demon. In this meeting we seriously considered murdering a Nobel-prize-winning scientist and a bishop of the Catholic Church, but decided instead to off a great writer because he was gay."

"That's not a fair description of what happened!" I objected.

"Political reporting is never fair," Campbell cheerfully pointed out. "Besides which, think how much trouble an accurate report of the meeting would make. We turned down a seemingly real opportunity to prevent World War II, the Holocaust, and African slavery. Just because our reasons were good doesn't mean a lot of people wouldn't be mad at us."

Nodding, I said, "And you guys had some fun at her expense pointing out all this."

"Yes," Campbell admitted, "but we couldn't help it. She was already mad at us for conning everybody into coming here for a useless briefing, and she kept going on about what a disaster the meeting was, how we blew a chance to prevent the Holocaust and unhappen slavery just to save a trunk full of manuscripts no one will ever be willing to read."

"Wait a minute!" I protested. "What do you mean, useless briefing? I know I wasn't a save-the-world hero, but I think, thanks to your briefing, I did some good."

"Oh, you did well, but the briefing we gave you didn't have anything to do with that," Heinlein said. "It couldn't. Atigon pulled all us out of one time line and put us back in another. That way the version of you that went to the meeting wasn't the version that got briefed."

"That's probably why Atigon took us to the meeting on sequential nights," Campbell explained. "First he told us that it was impossible to cause a causality reversal, a time-travel paradox, then he arranged matters so that it looked as if we had an opportunity to do just that.

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That way, if we didn't take him at his word, we'd wind up running a fool's errand."

"According to MacArthur, that's a good way to break in your staff," Heinlein added.

While all this didn't make much sense to me, I didn't want to continue arguing about time travel. Instead I asked, "John, what was that you said about a trunk full of manuscripts no one would be willing to read?"

"Think back," Campbell said. "Do you remember that during the meeting, Miss Bouvier said that without Marlowe's great works, children would grow up unable to read anything of any great complexity?"

"Yes, what of it?"

"Turns out it was true," Campbell explained. "People on that other timeline must have been much more literate than we are. I'm pretty sure I can get you a publisher, but the whole trunk won't give you anything like the sales you'd get from another Perry Mason novel."

"It'd be a little different if we could prove Marlowe wrote the stuff," Heinlein added, "but all we have is a bunch of manuscripts that will carbon-date to his time, but there no documents, nothing to explain how it got from England to—"

"Wait a minute!" I said, "You guys don't actually have the trunk, do you?"

"Sure, that's what Reagan and Teller are in your office reading," Heinlein said. "We were all there for a while, digging through this huge truck back full of manuscripts, trying to find something halfway readable."

"That was really what got Mrs. Kennedy mad," Campbell added. "We were all thinking that we'd saved all this great literature, and, in a way, we had, but we lost the world that had the literacy to appreciate it."

"Wait!" I protested. "How did you get this trunk? Where was it?"

Campbell and Heinlein were looking like small boys caught doing something they shouldn't. After an awkward silence, Heinlein said, "How we got it was an unpleasant story, especially for the Secret Service. As for where, well, you and your wife were both asleep and all of us got to talking. We knew that Atigon had promised to deliver the trunk following the human custom for 'discreet delivery.' MacArthur said that had to mean Atigon would send it in a plain brown wrapper, but then we saw that you had an extremely old outhouse on your property. We remember the alien's fondness for puns, and the outhouse is plain and brown, and Mrs. Kennedy swore it was our duty to humanity to recover the trunk as quickly as possible, so . . ."

"Was your wife very fond of that outhouse?" Campbell asked. "I'm sure we can arrange to get it rebuilt if—"

"No, she wanted the thing torn down," I said.

"Good. Then the only question is: what was your wife's maiden name? Was she Agnes Bethell?"

"Yes," I said. "She was the woman none of you could identify. She looked much older in the dream so I'm not surprised you didn't recognize her."

"That's water over the dam," Campbell replied. "Right now the important thing, Earl, is that she sat on your left. That could mean she was the first to go into the dream or that she's going to be the last."

Nodding agreement, Heinlein asked, "Did she mention having a strange dream eight nights ago?"

"No," I admitted.

"Then she'll be in the dream tonight," Campbell exclaimed. "Nothing is settled! The world is still in danger, and there's nothing we can do! Briefing her would be useless because the her that goes to the meeting won't be the her we brief!"

"Relax, guys," I told them. "Agnes has been my secretary for decades. She always puts the finishing touches on my work. We're safe as houses." ■

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The Late Sam Boone

Bud Sparhawk

Illustrated by John Allemand

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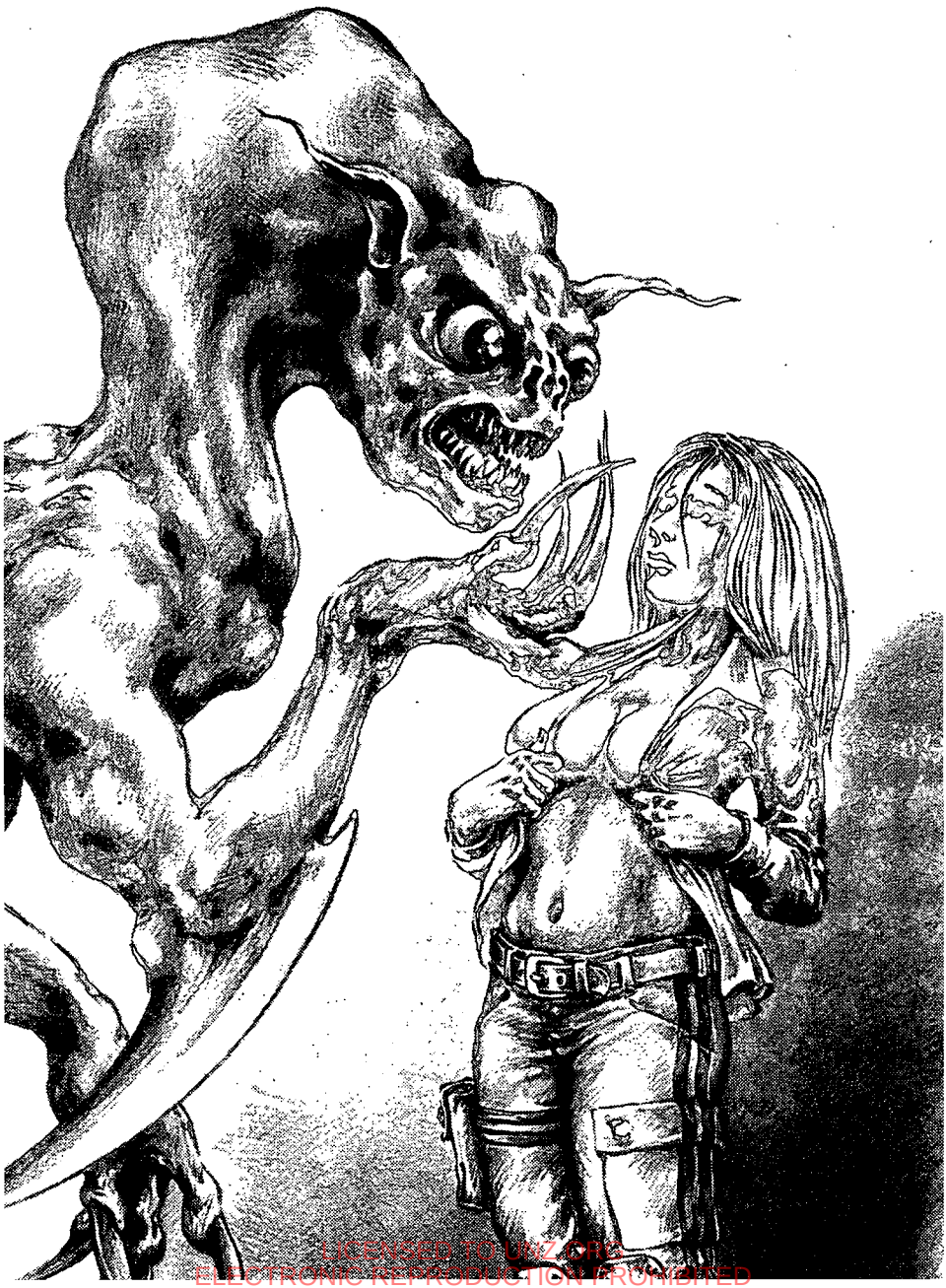
Appearances can be deceiving. . . .



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"Iz shuman pazzshing the name Zhambonne," Flenser, the Sith, hissed at the tiny human. "Iz your obligate to find and bring."

Roxanne Boldres tried to puzzle her way through the Sith's sibilant, heavily accented Glax. "Shambone?" she queried, wondering if she had gotten the name wrong.

The Sith drew back. "You have atrozzshiouzz accent to your zzshpeech. Is Zhambonne, as I zzshpoke."

"Hammond?" she interrupted, struggling to extract the proper name from the alien's sibilant mangling. "Or did you say 'Ham bone?'" That would have been an even weirder appellation but then, she was dealing with aliens so some weirdness could be expected. She hoped that her confusion would make the Sith give up and go away. She had no desire to play a role in that race's endless dominance games.

Flenser raised a tiny fore limb to expose the sharp claw at its elbow, a claw that could eviscerate her with a single downward slash. "Enough! I have no time for your word gamezz. Find this shuman Zhambonne and bring it to juzzhtice." The downward snap of the Sith's claw was so fast that, had Roxanne blinked, she would have missed it. Three of the buttons on her blouse popped free, severed of their threads by the razor edge of the claw's tip.

Roxanne gulped. "I appreciate the way you punctuate your sentences," she muttered, trying to keep her voice from fluttering like her open blouse, not that her exposed breasts mattered a whit to the three-meter-tall, vaguely saurian Sith. "So I guess I'm elected to find this Hammond/Hambone/Whatever-The-Hell-You-Said-It-Was person."

"Izz good. May you gorge on the warm entrailzz of your enemiezz," Flenser replied as it withdrew. Roxanne was somewhat surprised at this parting remark, which was, in the culture of the even. She listened as the sound of its clicking claws on the cold metal deck of the station diminished. Only when the sound faded entirely did she allow herself to relax. She did not like the Sith.

She'd arrived at this out-of-the-way station only a week earlier after being—owing to the Perigorian freighter crew's confusion about the rules of poker, the laws of probability, and an unwarranted suspicion of her consistent winning streaks—unceremoniously dumped. Since then she had been trying to raise enough to pay her passage off this frigid backwater station and onto a ship bound for warmer and more hospitable environs. The Sith's vendetta with this hambone character would seriously delay that effort.

There weren't many alien races on the station, which was an indication of how far this station was off the main track of interstellar commerce. Too prominent among the many races, she thought, were the Sith; tall creatures with tiny heads, thighs as big as barrels, and very, very sharp claws. That they chose to paint those claws in rainbow hues, with a bias toward fuchsia, did not diminish the effectiveness with which they used them to settle their endless disputes or, she thought as she gathered the edges of her blouse together, to make a sharp point.

Just the other day she had seen a pair of Sith settling some obscure religious matters *ex cathedra*. Both disputants had landed some effective blows that had thrown large chunks of green-gray flesh onto the deck. At the final settlement the only difference between winner and loser was that one had lost its head. She wished a few lawyers she'd known would open a practice here.

An assortment of other races managed the station's day-to-day activities. The Arasoes were vaguely humanoid, but only half as large as an adult human, with fuzzy bluish fur and bulging stom-

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seemed cute, but totally alien. After having dealt with various aliens in the dozen systems she had visited since smuggling herself onto a galactic tourist ship, anything with the requisite number of arms and legs that had an erect posture qualified as humanoid. Even the Sith sort of qualified, in a squeamish way.

The station's technical workings were maintained by Rix, a race of exceeding busy, tiny, insectile engineers. She ran across them everywhere she went, burdened with their ever-present tool belts, fiddling with the station's thousands of mechanisms while chattering cheerfully away in rapid-fire, acronymic dialogue. Conversations with the Rix, as with most engineers she had known on Earth, were enormously boring, that is, when they weren't totally incomprehensible.

For the sake of variety there were a smattering of resident shopkeepers, traders, huffle operators (whatever they were), and a precious few passengers en route to more exotic locations. One of the residents, Seeker, was her landlord—or so she had interpreted its role. It had allowed her the use of a tiny cubicle next to the station's frigid outer wall in return for lessons on the fundamentals of poker and how to bluff when the probability gods weren't especially helpful. Since they'd met he'd become an occasional advisor and a hell of a poker partner.

Seeker sighed when the sound of the Sith's claws could no longer be heard. "At least he offered to pay expenses so we'll be able to travel, you bet," he said in melodious trade Glax. It was a courtesy for him to speak Glax since she couldn't for the life of her understand his normal speech.

Roxanne shook her head. "I don't much like the idea of going after another human, especially when I'll have to turn him over to the Sith. That is, if we find him."

Seeker let loose a trill from his fuzzy depths. "No one likes the Sith. They are not pleasant creatures, even by my broadly catholic standards and especially since this latest dispute began." He paused, shook his scales and then continued. "But I do not understand why you are concerned. This Shammon person is a criminal. It did steal something of value."

"I know, I know," Roxanne said sadly. "Just the same, I don't like the Sith concept of justice." She shivered. "Turning somebody into flank steak is not my idea of the proper punishment for theft, even if it is something of religious significance."

"It is him or you," Seeker replied. "Sith hold the entire race responsible for the actions of one. It is why they have such power. They are extremists and you, being the only other human they have seen . . ." He did not need to complete the sentence. If Roxanne failed in her mission then she, not the perpetrator, would suffer their justice.

And she had no intention of becoming Sith sashimi.

"Well, I'd better get down to the surface and find this guy. He should stand out like an elephant in a phone booth among the natives."

"What is an elephant?" Seeker asked as they moved toward the drop bay. "And why would it be strange to find one in a phone booth?"

Sam Boone was worried. When Ahbbbb, his Perquodista agent, had sent him on this assignment to help settle the situation on Safehold she'd failed to mention the vicious and predatory nature of these damned Sith, who just happened to be his clients. Nor had she mentioned that the Sith were going to be religious fanatics in the worse sense of the word. All she did mention was that he was to protect their interests.

Safehold was the Sith's current target, the sixth in a series of relatively unopposed conversions of the natives' beliefs to those of the Alliance of Egg-Laying Be-

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ings. The Arasoes were the first to suggest they had no interest in converting due to irreconcilable differences.

"You nurture your eggs *ex utero,* while the Arasoes carry theirs about in pouches," Sam had pointed out gently during one of his conversations with Ripgut, the chief of the Sith delegation.

"*Haurgh.* It matters little," Ripgut had replied. "Eggs are eggs and all viviparous beings are the yolk-sucking enemy of everything right and good in the universe. Safehold's inhabitants must join the Galaxy's only true and just faith." To emphasize his point Ripgut drew his claws slowly and deliberately across the rough surface of the stone table.

It had taken nearly an hour for Sam's skin to feel normal again.

Matters had not improved of late. Due to the Arasoes' intransigence the Sith had threatened forced conversion upon them. Had the little furry beings been more technologically advanced, numerous, or spread over a few systems, Sam knew the dispute might draw the attention of the Galactic Hegemony's Court, which, owing to the tendency of the court's officers to quell disputes with draconian force, could be fatal to both races. Instead this little dustup appeared to be a minor infraction of the Galactic peace and not to be concerned about.

Although he was supposed to be helping the Sith, Sam instead had taken a liking to the Arasoes. They appeared to be nothing more than gentle beings with little apparent interest in anything outside of their little world.

Just having an Araso delegation discuss matters with the Sith had taken every bit of Sam's diplomatic skills. Those same skills were severely tested in getting them to pay serious attention to the Sith's proposal. They were far more interested in Sam himself—a terribly exotic being, by their measure, and one who had actually been to Disneyworld, which the Arasoes considered one of Earth's prime attractions.

Sam had tried everything he could think of to craft a solution, but to no avail. Every discussion started with the Sith's unshakable belief that, since the universe had sprung from an egg, only the egg-producing races were the Great Egg's rightful inheritors. That meant, they insisted, that all oviparous and ovoviviparous beings were honor-bound to gather under the Hatch of the Great Egg's banner. The Arasoes, therefore, had no choice but to join the cause. To do otherwise was to deny their inherent destiny.

Sam had tried to argue the premise, but quickly realized that tampering with holy writ was exceeding dangerous for a frail human whose fingernails were an inadequate match for the large, sharp, and colorful claws of his clients. As a result he found himself, excuse the expression, walking on eggs whenever he sat down to negotiate.

Ripgut, the chief Sith negotiator, hissed at Sam as he entered the chill meeting room. The translator on the table emitted only a series of high-pitched groans.

"*Click-click-clickeddy-click.* Wait a damn minute until I get this gadget adjusted," the little Rix engineer chattered through his personal translator as he probed the translator's innards. "Cheap-assed Pequodista crap never works when you need it. Why the stationmaster went with the lowest bidder . . . Aha! There we go!" A fountain of blue sparks flew out of the upper horn of the translator as the Rix jerked spasmodically. "*Click-cli . . . zzzzz!*"

"Say something," the Rix instructed Ripgut as he shook his smoking appendages to put out the fire.

"I said, may you dine on the rotting entrails of your enemies." Ripgut's voice announced from the lower horn—a warm welcome from a Sith, Sam thought.

For some reason the chief negotiator had today chosen to paint his eyebrows a deep purple and tinge the edges with rose. His lips, Sam noted, were still

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smeared with the same bilious green coating he'd worn at every meeting while his claws remained their usual fuchsia, a color that seemed sedate and conservative in comparison to the rest of the color scheme.

"May your claws rip the unborn from the bowels of the unbelievers," Sam replied formally, shivering slightly when he realized that said unbelievers could only be the non-egg-laying majority of the galaxy, which included his own abdominally soft race. A series of leaky radiator hisses emerged from the middle horn on the opposite side of the table. This horrendous statement produced a flash of serrated teeth from Ripgut. Sam hoped it was a smile.

As they were exchanging pleasantries, the rest of the Sith's negotiating team had staggered in. Sam was continually surprised by the mixture of colors the Sith used to enhance their stark, scaly unloveliness. In fact, he wondered if they were completely color-blind, so clashing were their choices of makeup. He would never, not ever, choose to paint eyebrow ridges a putrid brown and garnish cheeks with bright orange splotches like two of Ripgut's side-saurians. While they all emulated their leader's bilious green lipstick, their claws were shades of blue, red, or green, which further strengthened his low estimation of their fashion sense.

Three of the Arasoes, led by Hoppergoinglightly, the leader of the Araso team, followed the Sith and hopped to their places at the table. Each Araso was conservatively clothed in sedate checkerboard-patterned jackets with matching skirts. Hopper's lieutenant, Sam noticed with a start, was showing a decided bulge in the abdominal region. In fact, said bulge was straining the buttons of that individual's jacket.

"You are with egg, Leaperforthewind?" Sam ventured quietly as the Araso settled into place. The translator produced a melodious sound not unlike a clarinet quartet.

"*Too-too-tootle.* Yes," Leaper beamed in melodious tones. "My mate delivered our egg only this morning."

Sam hesitated. "Delivered" could mean another Araso had laid an egg, or had, for all he knew, sent the damn thing up to the station on the morning shuttle. "Was it a difficult delivery?" he ventured, hoping to gather further illumination.

"Not at all. Only two transfers were necessary," Leaper replied, which clarified nothing.

Ripgut's voice hissed angrily from the translator. "Cease this irrelevant chatter. We must settle matters once and for all,"

"We are quite pleased with the progress of this game," Hopper announced pleasantly and sat back, tail twitching in happy syncopation to his tootling.

The translator hissed and tooted as it tried to keep up with the buzz on conversation. To Sam it sounded like a cage arrangement for clarinet and steam radiator.

"I admire your fortitude, but it wastes time," Bowelsplitter, Ripgut's chief enforcer, hissed as he clicked his claws together, making a sound like ginzu knife castanets. It was a calculated insult.

"And I your delicate aroma," Hopper replied calmly and sniffed. "Interesting. Is that smell your latest waste or did you find someone else's to bathe in?"

Bowelsplitter tensed as he prepared to spring across the table, but Sam intervened. "We agreed that I should negotiate the talks between Hoppergoinglightly and Ripgut, did we not?"

"So we did," Ripgut replied and slapped Bowelsplitter on the side of the snout. The sharp edge of his elbow claw just narrowly avoided the aide's nose; otherwise, Sam thought wryly, Bowelsplitter wouldn't smell at all. "So, speak!"

"It seems that the two of you are held apart only on matters of theology," Sam began as diplomatically as he could. "The Arasoes wish their people to re-

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main ignorant of the Great Egg and the blessings it may bestow upon their race."

"They are infidels who need to be brought to the light," Ripgut interrupted sharply. "They must allow our missionaries to bring the truth to their people."

"But surely you understand," Sam continued smoothly, "that you cannot impose faith on those who don't chose to believe. The Arasoes are quite happy to worship in their own manner."

Ripgut sliced to the core of the matter. "The Hatch of the Great Egg shall bring truth to the ignorant masses and eviscerate all who fail to see the light!"

"That's the Universal Hatch of the Great Egg, isn't it?" Bowelsplitter interrupted as it touched its green clawpaint.

"Whatever," replied Ripgut with a casual wave of dismissal that nearly sliced Bowelsplitter's ear off.

"We do not want missionaries," Hopper replied. "We want to play. Your religion is of no interest to us."

"You only wish your oppressed masses to continue to suffer injustice under the heels of other egg-sucking aliens." Ripgut said calmly. "We cannot allow you to remain backward and unenlightened. A fleet of armed missionaries will arrive to help you see the light, but don't worry. I am sure you will find conversion brief," Ripgut showed his teeth. "And quite efficient."

Sam gulped. Ripgut hadn't mentioned missionaries before and the added note about armaments did nothing to improve the situation. A quick glance through his handy galactic encyclopedia (another costly item his agent had sold him) later told him that the Sith were not above using anything up to and including nuclear weapons to bring the true faith to the unwilling. Unless he was successful, there was going to be a bloodbath, with him caught in the middle.

Hopper didn't seem to appreciate the seriousness of the situation. As Sam recited the arms the Sith missionaries sported, Hopper thumped his tail happily and tooted. "This is wonderful. They are quite serious about this, aren't they?"

"Don't you understand that they're going to attack you?" Sam replied. "Guns, troops, tanks, missiles, and who knows what else." Hopper appeared unmoved. Perhaps, Sam wondered, the Arasoes had no words, no concepts for war and weapons. If so, then even the Great Egg couldn't help these defenseless creatures before the might of the Sith.

Despite his contract with the Sith, Sam felt that he had to help the Arasoes. Clearly the Sith weren't the ones who needed his advocacy—they appeared quite capable of taking care of themselves, quite unlike the gentle Arasoes. Somehow he had to stop this conversion before it inflicted who knew how much suffering on its innocent inhabitants.

He just wished he had a clue as to how to bring this about.

The drop site was nothing more than a grassy, overgrown field. Roxanne had to wait in the shuttle's hatch until a few languorous natives pushed a portable ramp into place. A single stone terminal stood at the far edge of the field. Far beyond she could see a cluster of low and rambling structures that followed the rolling countryside's contours.

Inside the terminal was a low partition separating a drowsy official from the line of de-shuttling visitors. "*Toot-toot-tootle?*" the official sang as Roxanne approached.

It had been a long walk from the shuttle and her kit was growing very heavy. "Cripes, don't you even have a translator here?" she said angrily. "Do you speak Glax?" she said in the galactic lingua franca.

The official looked blankly at her. "*Toot-toot?*" it sang, a query in B flat.

"*Tootato-too-too,*" a purple thing with five appendages standing behind her

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translated quickly and then, in an aside to Roxanne, "I told him you." Not that he needed to—all she had were the clothes on her back.

"*Toot*," the official said and swung the gate open to allow her to pass before singing to the purple pentapod. The official pointed at the large bag the purple thing was carrying. Roxanne missed most of what the octopod replied, but didn't miss its delicate orange flush of embarrassment. Maybe it had a few undeclared egg coddlers in its baggage, she thought.

Roxanne looked around as she exited the terminal. Aside from the distant town there appeared to be nothing around but endless plain, no different from the place where the shuttle had landed.

Here and there she spotted Arasoes racing along, bodies held nearly horizontally to the ground as they took tremendous, distance-consuming leaps with rapid kicks of their powerful legs.

Two Arasoes suddenly appeared, as if from nowhere. "*Too* . . . " one of them began and then, as if sensing Roxanne's inability to understand, switched to a melodious Glax dialect. "Is time you here arrived. We have waited patiently for a custodian to rid us of this obligation."

Roxanne looked blankly at the aliens. "I have no idea of what you are talking about."

"The corpus, the evidence, the obligation to respect the departed. You must your customs explain so we can make arrangements."

"Just who the devil are you and why do you think we've come for somebody's body?" Roxanne asked.

"Burrowingintoheaven," the creature replied. Slowly, using her understanding of the Araso's limited Glax, an explanation emerged. Apparently someone matching her body configuration had died a few weeks earlier. Burrowing, as custodian of the remains, had requested the station to locate someone from that being's race to collect the remains.

"It was a human?" Could this be the guy she was after? It sounded awfully coincidental. How many humans could there be in this godforsaken part of the galaxy? Still, much like her poker hands, the laws of probability seemed to bend in her favor. Still, why wouldn't Flenser have known of Hambone's death?

That was a very interesting question and one she had to pursue. She turned to the Burrowing. "Where is this body?"

Burrowing pointed to a cluster of shacks on the horizon. "There," it tootled. "That's where we put the murdered remains."

"Murder?" Roxanne replied. This situation was rapidly spinning out of control. What had she gotten herself into? She sighed. "Let's take a look."

Sam was so beside himself with worry that he couldn't sleep. There had to be some way to avert the disaster that was coming. He was absolutely certain that the gentle Arasoes would be unable to resist the conversion by the Sith missionaries. The only question was what they would be converted to.

Thinking a little exercise would help, Sam left his cubicle and began walking the corridors that ringed the station. There was the normal number of aliens swarming about at this unholy hour of the night. It was "night" only by Sam's internal clock—who knew what strange schedules paced the others?

A drool of Rix appeared and established a phalanx across the corridor a few hundred meters ahead of Sam. Half a dozen deployed to either side while the rest began erecting a barricade. In a matter of seconds they completely sealed the corridor ahead of him.

Sam turned and discovered that a second drool of Rix had done the same behind him. "Hey," he yelled. "How am I going to get out of here?"

One of the Rix looked up and scratched its insectile head. "What the hell are you doing here? This area has

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been condemned. We're going to vacuum-clean it." The Rix pointed to where a trio of Rix were cutting a huge hole in the ceiling.

Sam gulped. "I can't breathe vacuum," he shouted. "Get me out of here!"

The Rix scratched its head again as it consulted a small book of tables. "It says that there's no one in this corridor at this hour." It checked another book. "No, I'm afraid the work order doesn't include rescuing aliens. Sorry."

Sam was desperate. The trio of engineers had already completed three quarters of the circle that would certainly open the corridor to the emptiness of space. "Listen, I represent a very important client who would be quite upset if I were to die."

"Die?" the Rix asked. "Would your death be very messy? My team doesn't have the resources to do a lot of extra cleaning."

The trio had nearly completed the circle. Sam could hear the whistling sound of escaping air. He looked around for some way out. There! It was a small doorway with a huge handle on its side—obviously a pressure door. With speed and agility he didn't realize he possessed he leaped, threw the handle, swung the door wide, and plunged inside.

No sooner than was he inside than he felt the air rushing past. The door slammed shut, blocking any further loss of pressure. Obviously the Rix had begun "vacuuming." For a moment he wondered what had happened to all the little engineers—he hadn't noticed any protective gear, but maybe that hadn't been in the work order either.

Sam looked around. The corridor was dimly lit by a long glowing tube that ran down the ceiling. Judging from the number of pipes, wires, and boxes mounted on all sides this had to be a maintenance tunnel. Sam began following the light to see if it would lead him to another exit.

Eventually he came to another door, a small one that he could barely squeeze through. It opened to a dark compartment that reeked of Sith. Sam fumbled about, trying to find a switch that would give him some light. Then he stopped. What if this was a Sith's private quarters? And what if that theoretical Sith were suddenly awakened? Sam gulped. He had no desire to become shish-ka-Sam. His elbow struck something, nearly knocking it over. He caught it before it fell over and held on.

It felt like metal—lumpish with a thin handle. Sam began to put it back and then realized that it could serve as a defensive weapon. A few blows from this interstellar hand axe probably wouldn't deter an angry Sith, but it gave him reassurance.

Carefully he began to feel his way around the room with his free hand, inch by inch, letting his probing fingers follow the wall until they encountered the edge of a large panel. No, it wasn't a panel. It was a doorframe. Sam let his hand explore, seeking for a handle, a latch, a pressure panel that would free him. There! It was a simple release mounted in the door's middle.

With great care Sam pushed on the release and cracked the door, letting a shaft of light into the small room. He hesitated, to let his eyes accommodate and to make certain that the room held no slumbering Sith ready to leap and rend.

What lay on the other side of the doorway was quite unexpected. It was a large room filled with rows of benches. The walls were painted with frescoes of luminescent hue depicting heroic-sized Sith disemboweling various races, smashing fanciful cities, and raising a huge ivory egg atop a long staff. What was more interesting was that there was a similar staff with egg on the pedestal nearby. Sam was initially overwhelmed by the splendor until, two milliseconds later, he realized that this could only be a Sith church. Of all the luck in the universe he had managed to emerge inside their holy of holies.

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Sam thought fast. He had to get out of here. He raced for the back of the church and found the door. Taking a deep breath and saying a small prayer that there wouldn't be any Sith waiting outside, he dove through.

Thankfully, none of the aliens wandering by were Sith. Sam let out a sigh of relief and began to walk down the corridor toward his compartment, much relieved.

The Araso city was only a few kilometers from the shuttle terminal. Roxanne felt somewhat uneasy dodging leaping blue beings within the narrow confines of the hop ways, but followed the Araso mortuary officer until they reached a shack that might be a funeral home, for all she knew. Morgue?

"That's not much," Burrowing remarked as he unwrapped the tiny box holding the human's remains. The box measured a bare twenty centimeters along any edge. "We had to burn the unfortunate's corpus," Burrowing blared. "It had begun to smell and we did not know how long it would take before someone would come."

That seemed logical. A month had passed since Hambone's death and, without any knowledge of how to preserve a human body, they probably did the proper thing. "How am I expected to know if this thing was human?"

Burrowing withdrew a larger package from a nearby bin. "These were the creature's possessions."

Roxanne slowly unwrapped the package. "This could fit," she remarked as she held up a set of coveralls. They were two sizes too large for her, but had the right number of arms and legs plus, she noticed, something proved that the owner must have been male. The right to left closure was a tiny detail an alien could easily overlook if they were faking this.

The most frightening aspect of the coverall was the long diagonal rip that ran from neck to navel, and around which was a dark stain. *Dried blood*, she wondered? "Anything else?"

Burrowing handed her a small silver translator. "Looks like Rix work," he said as she turned it over and over. "Say something."

Roxanne paused. "What the devil do you want me to say?" Much to her surprise the box erupted with a melodic string of tootles that were obviously Araso speech. "It's tuned for a human," she said in wonder.

"And who else but a human would carry such a device?" Burrowing remarked as he continued to pull things from the package. "Ah, here's an ID. Can you read it?"

Roxanne took the smooth piece of plastic and read the standard inscription below the picture. "Sam Boone," it read in English and in Glax.

"I think I just found my quarry," she gulped. And damn if he hadn't been sort of cute, she thought to herself. Regretfully, judging from the long tear in the coverall and the amount of blood she'd seen, the emphasis was on the "had been."

And the rip could only have come from a Sith's deadly downward slash.

"I still have a problem," Roxanne mused aloud over a mug of warm Araso beer, somewhat too bitter for her taste, but acceptable. The salty nuts that were served with it were delicious, if somewhat difficult to crack. Finding this Boone guy was only part of the problem. The other part was finding whatever religious item he supposedly stole. The only certainty was that a slashed overall that told her another Sith was involved.

That presented a problem. Burrowing knew nothing of why this Boone guy had become so dramatically and suddenly deceased, or how long the body had been there when it was discovered.

Obviously, the murder site's the obvious starting point for any further investigation, she thought.

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The Sith were in a foul mood the next morning. All of them were clicking their claws in rapid syncopation and hissing at a furious rate. Ripgut was missing and one or two of the others had some seriously fresh wounds. Sam wondered if it had anything to do with the strange decoration job someone had done on the walls the previous night. The large smears of green and red seemed to follow no special design, but he was not one to judge the Sith's aesthetics.

Sam couldn't make out a word of what was agitating them since the translator had chosen to malfunction once again. Instead of Glax emerging from the horn there was a bleating, raspberry sound.

Click-click-chirp, the little Rix engineer complained in a rapid-fire string. "Why didn't I sign up for something easier, like engine maintenance or air treatment? But no, everybody said translators were the coming thing. Everybody needs translators, they said, job security, that's what. Ha! Now I have to deal with every piece of dreck that . . . Hello, what's this?" It held up a fuchsia-colored object. "How did this get in there? That's what's been gumming up the works."

Sam glanced at the object in the Rix's tiny pincer. It was a Sith claw, and it was the same color as Ripgut's. "Was there an argument after we left yesterday?" he asked, suddenly realizing what the torn claw and smeared wall implied. He felt sick to his stomach.

"I hope you slept well," Bowelsplitter replied ominously. "We certainly did not."

The absence of the usual insult meant that the Sith were in a really bad mood. Worse, the implication that somehow they had discovered Sam's nocturnal perambulations sent a shiver down his back. "Where is Ripgut?" he asked with trepidation.

"I am now chief of mission," Bowelsplitter replied haughtily. "Owing to a failure to respect the Great Egg properly this morning Ripgut was, ah, deposed. We are now the Universal Great Egg delegation. "

Sam suddenly realized why all of the other Sith now wore Bowelsplitter's shade of lipstick—a sign of acknowledgment and mutual support, no doubt. He was a little surprised to learn that Ripgut had held a religious role, a role that Bowelsplitter had gained. Sam wondered how he could use that bit of knowledge, but before he could pursue this line of questioning any further the Araso contingent arrived.

"Good morning," Hoppergoinglightly warbled brightly.

Bowelsplitter leaned forward and hissed menacingly. Both claws were raised into striking position. "So this is how you treat emissaries of the Great Egg. Not only have you repudiated the Truth, but you violate our sacred persons as well. Do you want me to inform the missionaries that you are unworthy of conversion? I assure you that they are quite capable of changing their objectives."

Hopper leaned forward, putting his head within range of the deadly claws. "We look forward to having your missionaries play with us." Hopper's tail was thumping vigorously.

"Play, you think? Better tread carefully, infidel," Bowelsplitter warned. "The Universal Great Egg is not to be trifled with."

"Excuse me," Sam said. "Can I ask what the problem might be? What's going on?"

Bowelsplitter snapped his claw downward and sliced a chip off the stone table. "Unlike Ripgut I will not deviate from the true faith or my duty. I will conduct my own investigation, and when I discover who has committed this outrage, I shall deal with them. Directly!" he emphasized with a second slashing blow.

"We should not jump to conclusions," Flenser interrupted. Since Flenser sat to

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the left of Bowelsplitter, Sam supposed that he was the new second-in-command. "They appear to be unknowing."

"I will tolerate no criticism from a damned apostate," Bowelsplitter sputtered. "We follow the tenets of the Universal interpretation or none at all." For a moment it appeared that Flenser was about to attack, an action that would probably be deadly for everyone not a Sith in the room.

Then he retreated. "As you wish," he muttered like an exploding steam engine. The sounds of his teeth grinding sent shivers up Sam's back.

"Do you have any idea of what they were talking about?" Hopper asked Sam in an aside.

"None whatsoever," Sam replied. Right at the moment he was more worried about the fleet of overly zealous Sith who might even now be approaching at superluminal speeds, and what they might do, than an argument between two heavily armed aliens. Safehold had no large cities, no industrial sites, no apparent advanced technology of their own. No wonder the Sith thought they would be pushovers.

Just the same, he hoped that nobody had noticed him slipping into the corridor the previous night, or wondered why he'd been inside the Sith chapel. He looked at the chunks Bowelsplitter had taken out of the table and gulped. He certainly didn't want to inflame the Sith any further. Perhaps he should try to work with Flenser, who appeared to the lesser of the nasties.

The obvious place to start was where they had found Sam's mangled body. It wasn't that far from the terminal—a short walk, Roxanne found out, just over a hillock and a few steps into a vale. Anyone standing there was pretty well hidden by the surrounding landscape. You'd have to be just a few meters away to see whatever had happened there.

In other words, it was a perfect murder site.

There had been several rainstorms since they'd found the body, so there was little evidence of the bloody handiwork to be seen. Nor were there other signs that might reveal interesting information, such as whether there had been a struggle.

"There were three Sith bodies as well," Burrowing remarked as Roxanne investigated the scene. Now that was interesting, she thought. It indicated that more Sith were involved—a human's puny strength wouldn't have been a match for even one Sith, let alone three of them.

Clearly, it couldn't have been these cute Arasoes.

The big question was whether the stolen artifact had been the motive for the murders. A crime of passion was certainly out of the question. Perhaps the other murders were simply a way of silencing the witnesses to a second theft? That theory might be a strong possibility, but who was the murderous Sith and where might he, and the relic, be found?

Roxanne tried to trace Boone's movements. She discovered, after tooting it up with the shuttle port officials, that he wasn't spotted in town after he got off the shuttle. That meant that the murder must have happened right after the victim had landed, which tied with the time when Flenser said his relic was stolen. That also meant that the murderer must have followed Boone to the planet.

Unfortunately, the timing meant that whoever had done this had had nearly a month to make their escape. There was no way she could follow a trail that cold.

Sam sat in his cubicle trying to think of some way he could reach accord between the two parties in this dispute. Anyhow, dispute was not the word he would have chosen. It was more like a monstrous takeover of a planet by a bunch of bloodthirsty reptilian fanatics. How anyone had ever thought that he could arrange peace between these par-

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ties was beyond him. He might as well try to defend a plate of prime steak from a pack of ravenous rottweilers.

Sam pulled another of the delicious Safehold nuts from the bowl and smashed it with the heavy metal lump he'd found. Ugly it might be, but it made a fine nutcracker. He crunched the meat as he thought of what form the inevitable disaster might take—a softening flock of smart bombs followed by an armed assault would fit the Sith character. Of course, they would probably sing hymns in the process and take up a collection afterward, that is if there were any survivors left to contribute. He smashed another nut: just like the Sith would smash defenseless Arasoes.

"May I enter?" Hopper blared from the doorway.

Sam was grateful for the interruption. "Come in, come in. Have a nut or two."

Hopper settled himself on his haunches, picked up a handful of nuts and tossed one into his mouth. There was a crunch as he bit down and then swallowed. A second nut followed. "The shells contain most of the nutrients, you know."

Sam smashed another nut and examined a bit of shell. Judging from the force it took to break it he doubted if his teeth were up to the task. Besides, he already had enough iron in his diet.

"What's going on with the Sith? Any progress on finding out what's bothering them?"

Hopper sighed in B minor. "I cannot say, although there does seem to be an internal struggle for leadership. I noticed several different shades of lip paint today and rather more noticeable wounds."

"Promotion comes hard with the Sith, I would imagine," Sam said as he whacked another nut. "These really are delicious."

"I've also noticed that Bowelsplitter is the only one in that service hall of theirs. The rest just mill around outside and fight among themselves. Occasionally one will enter, only to emerge bloody, if at all. I assume they are fighting for possession of the Great Egg's Finger."

Sam paused in mid stroke. "Finger?"

Hopper crunched a double nut mouthful. "Yes, an artifact that is their symbol of leadership. Only those who can produce the Finger are allowed to lead the pack."

"Any idea of what the thing might be?" Sam said as he broke a few more nuts.

"Only that it's very old—an artifact of their first victory. I think it is the melted remnant of some weapon or other."

Sam raised his hand and stopped. Very carefully he placed the nutcracker on the table and stared at it. The surface was smooth, as if the metal itself had flowed under great heat. It could have been a sword or a spear or a gun for all he knew. But what he realized with alarming certainty was that this thing he'd been using so casually was the Sith's most venerated religious object.

Hopper stared as well. "Is that what I think it is?" he wailed.

Sam nodded and then explained in one great rush just how he had come to have it in his possession. "But I don't think they'd appreciate any excuse I might provide." He paused. "Uh, I think a few of the station residents might have seen me," Sam recalled. "If they say anything . . ." He didn't need to finish.

"We've got to get this off the station," Hopper said at once. "And you as well. The Sith are already mounting a full investigation. We certainly don't want anything to happen to you when they find out . . ." Sam noticed that he didn't say "if."

"Where the hell am I going to hide?" Sam asked as the panic started nibbling at his tender edges. "I stand out like an elephant in a phone booth."

Hopper cocked his head. "What is a phone booth? No, never mind. Come, I'll get you on the shuttle. Don't worry. We'll take care of you. Matter of fact, it is

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in our best interest that we get you out of the way."

Sam agreed, but he knew that flight was only a temporary expedient at best. There would be no hiding once the missionaries arrived.

None whatsoever.

Roxanne was knocking back her third beer of the evening, trying to shut out the misery of her failure to produce a single idea of what to do next. As she tried to smooth out the wrinkles in her worry lines she assembled the facts she had to see if there was anything she might have missed.

The problem was that every answer raised a new question. First, the Sith was pretty certain that Sam had taken the relic, but if they knew that, then why hadn't they stopped him from leaving the station? Well, maybe they hadn't yet discovered that he was the thief. Maybe they found that out later.

Second fact: Boone had been killed soon after landing and, according to a few witnesses, had been seen talking to a Sith as he exited the shuttle. Had that Sith been the one who killed him? If so, then what happened to the relic Sam was undoubtedly carrying? And why wouldn't a Sith return it to the station? Maybe her patron wasn't the only one interested in recovering the relic.

She had no assurances that Flenser, the Sith who was employing her, was the relic's rightful owner, just as she had no knowledge of whether the one who had killed Boone had been either. Come to think of it, why send a human to find another human? Why not just send a couple of Sith to smell him out?

Which gave rise to another disturbing thought. "Maybe I'm just a stalking horse," she mumbled. Just a pawn thrown into the mix to confuse and compound whatever dominance game they were playing? Or did they think that another human would attract the wayward and now sadly departed human? There was no way she could be certain. All she had was guesswork and supposition.

"Maybe it's a mistake to think too deeply on matters such as these," she said to no one in particular. Her energies might best be applied to dealing with the solid evidence she had at hand.

Hah! Evidence. What did she have, after all? A ripped overall, a Rix translator, and a picture ID? Those don't seem very solid.

Wait a minute, she thought, bolting to upright attention. Why would the rip in the overall extend from the upper breast to the opposite hip? A simple swipe across the throat would have been much more efficient. Furthermore, a downward slash by an erect Sith would only go half the distance of neck to groin.

"Maybe it was a very short Sith," Roxanne mused. The slash had to come after, while the body was on the ground. Maybe the murderer tried to open the coverall up so he could search the body? But why was the blood only around the gash? Something was wrong with that picture.

Could the attack have been staged? Was the demise of Boone a red herring? She paused. It was awfully convenient that they cremated his body. More interesting was that the only possessions she was shown were those that plainly identified the human victim.

And that, Roxanne thought, was *very* interesting indeed.

"Taking a break from negotiations?" hissed the Sith who matched steps with Sam as they passed through the shuttle gates. This one wore red lipstick and rouged his cheeks in bright blue. Sam didn't think the colors did anything to improve his appearance. "Raptor," the Sith introduced himself in sibilant Glax. He didn't appear to be one of the Sith negotiating crew.

Sam started sweating. "Sam Boone," he answered curtly. It was quite unlike a Sith to start an idle conversation with an

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alien. "Yes, just taking a few days off to see the sights," Sam replied. "You know, visit the monuments, see the vistas, hang out with the locals—the usual tourist stuff." He hoped the Arasoes had monuments, vistas, and places to hang out.

The object Hopper had put in the bottom of his bag felt as if it weighed a thousand tons. He was certain that anyone with an ounce of intelligence could see its contour through the thin fabric despite the wrappings he'd placed about it.

He swore that Raptor was giving the bag an intense glance as Sam hoisted it onto his shoulder. "Do you need some help with that?" Raptor asked as he reached one clawed hand toward the bag.

"No, not at all." Sam turned to keep the bag away from the reaching hand. He tried not to wince as the strap cut into his shoulder. "Well, I'd really like to continue our little chat but I've got to get to my seat, stow the bag and all that. The shuttle won't wait. See you." He knew he was babbling but if he stopped talking he'd probably start gibbering in fear. Not that it would make a difference in the output.

"May the blood of your foes be thinned with tears," the Sith replied cheerily. "Perhaps we may pray together on Araso." Sam wondered if he had meant "prey" or "pray." Of course, with the Sith, they could be the same word.

When Sam turned from stowing his bag he noticed that Raptor had taken a seat right across the aisle. The Sith's attention seemed to be fastened on the bag, a bag which Sam was worried might suddenly turn transparent to reveal everything to the deadly alien's sharp eyes. But then, perhaps that was simply Sam's imagination run riot. There was no way the Sith could know what Sam and Hopper were doing—was there?

Sam tried to stay calm, but his mind kept returning to the bag and what might happen it should suddenly open before he was safely on Araso. Oh lord, it hadn't been his imagination. That Sith *was* staring at him with a malicious gleam in his eye.

Sam was glad he'd had a clean pair of pants in the bag. He was certainly going to need them.

The shuttle ride was mercifully brief and ended with tremendous jarring that would have made most of Earth's air crashes seem perfect landings. Thankfully everyone was restrained in their harnesses, unlike most of their recent meals. Sam marveled at the variety of aromas, colors, and textures that splattered the forward wall of the cabin.

A shaken Sam wobbled, bag in hand, through the hatch and down to an open field dominated by a single stone building.

Raptor was waiting for him at the base of the ramp. "Come," he said. "I want show you something very interesting." He clapped an arm across Sam's shoulder, which placed his claw's edge a bare centimeter away from Sam's jugular.

"Whatever you say," Sam squeaked, careful not to nod his head. He let the Sith lead him over a hill and away from the lone building and its relative safety.

Sam knew he was breathing his last when Raptor offered to take him on a little hike. And when he saw the other two Sith waiting for him he was certain that his imminent death was going to be both messy and lingering.

"Your bag," Raptor said. Sam obligingly dropped the bag at his feet. The Sith withdrew his arm immediately. "Do not try to run," he warned as he kicked the bag toward one the waiting pair. "I believe there is something interesting in the bag. He certainly doesn't have it on his person."

"Yes," the other Sith said. "We must let Bowelsplitter know that his is not the only egg in the clutch. Others have more right than he who engineered Ripgut's demise. We need to put a claw

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in that damned orthodox bastard."

Sam didn't take his eye off the Sith. How far was he from the building and safety? Could he get to the ridge and in plain sight of witnesses before he got eviscerated by the trio? He estimated the odds against that happening at twenty billion to none.

The Sith were about as gentle with his bag as a New York customs agent. In seconds all of Sam's possessions were scattered about the landscape; his spare coverall and his last pair of tweety-bird briefs. His Stygian toothbrush landed near his feet.

"This is not what you promised," the kneeling Sith screamed as he held up a heavy, reeking mass of vegetation, a souvenir from one of Sam's previous assignments. For a moment Sam was hopeful that they would take the smelly thing off his hands

Raptor threw it down and turned on Sam. "You have tricked me," he hissed. "I will make you pay for such deception." With a scream he launched himself at Sam, his arm raised for the deadly downward slash.

Sam awaited the assault without flinching. Actually he was frozen solid with fear; every muscle had clenched in anticipation of the strike. He barely had time to close his eyes before he felt a hard blow that sent him spinning into darkness. His last thought was of Earth and all the lovely young women he'd never met.

For the past two days Roxanne had been trying to figure out some way she could find the truth behind the evidence that Sam Boone was dead. Getting an independent analysis of the ashes might or might not prove something. Would the ashes of a Sith or an Araso differ markedly from a human's? She had no guarantee that they would, so there had to be another way.

Now, who stands to gain by possessing the Finger, she wondered as she pursued this line of thought. If she could discover who was keeping the Finger out of sight, she'd probably know what was really going on. Roxanne reached out for a beer to help her think about that strategy.

"I did not pay for you to pleasure yourself." The sharp tip of Flenser's claw struck the table between her thumb and extended fingers just before they closed on the handle of the mug.

Roxanne didn't twitch. "Well, I didn't expect you to come down to check on my progress," she said as calmly as she could under the circumstances.

"I expect results forthwith," the Sith hissed with menace, she thought; but then, everything the Sith said sounded menacing. "The time draws near for a reckoning and we must have the Finger returned to us."

"I'm following a couple of leads," Roxanne said. "We think we know where your Shambone has gotten himself. Give me a few more weeks and I'll have this all wrapped up for you."

The Sith rested its claw against Roxanne's throat. "Do not lie to me. I know that you examined the other human's remains and did not find the Finger. That is, unless you now have it in your possession?" His hand pulled her chin upwards to stare into his tinged eyes—a delicate orchid shade, she noticed.

"No, no. I haven't seen it. All I found were the normal things a man might carry—nothing remotely Sith."

The claw lingered at her throat a moment more and then snapped away, the claw's tip nipping her earlobe. "I will either have the Finger returned or extract payment from another human—of whom you seem to be the sole representative."

"Why are you so anxious to get this thing back?" Roxanne asked. "What's the urgency?"

"Fool. Soon our missionaries will arrive. I would have this in my possession so that I might rightfully direct them to bring the light of the Universal Great Egg to this benighted planet."

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"What happens if you don't have it?"

"You will not be concerned with that," Flenser snapped angrily. "I assure you that you will be well beyond caring about such matters if that occurs."

The downward slash of the claw was so quick that had she blinked she would have missed it. She looked down at her blouse. "Damn, what is this thing you guys have with my buttons?" But the Sith didn't hear. It was already walking away.

Once her heart stopped pounding she realized how strange it was to see Flenser here. It strained credibility that he would do so only to urge her to increased productivity.

Maybe he had a thing for blondes with big boobs, Roxanne thought as she tried to fasten the loose halves of her blouse. She finally gave up—there wasn't anyone around to care anyhow.

Half a beer later a very disturbed Araso wearing a blue smock appeared beside her. "Didn't we tell you to stay in the bunker? Come, you must go back before the Sith sees you!" She was impressed. Sam's translator was really good at the local language.

"You're a little late for that, friend," she replied, but the Araso lifted her over its shoulder and sped from the bar. As they raced across the plain the little blue creature was tootling up an excited storm about games and playing and preparations, most of which was completely incomprehensible to Roxanne, as it pulled her along.

". . . urgent that you be safe. Preparations must be made for . . ." The Araso said something about a million Sith warriors coming soon. Roxanne shuddered at the thought of what that many armed Sith could do to the gentle beings of Safehold.

Instead of the panic she was certain a similar crowd of humans would be exhibiting when they learned of such impending doom, the Arasoes appeared remarkably calm, nor did their melodious voices sound panicked. The scene was quite orderly, as if prospective invasions were a matter of routine.

Try as she might, she could not get the small Araso to release her. Who would have thought these little creatures could be so strong?

They made several confusing twists and turns, each one taking them deeper into the town. None of the Arasoes they passed seemed to think her presence anything out of the ordinary.

At last they came to a building with a thick, barricaded door. They hit the door at full speed, slamming the door against the wall.

"You were supposed to keep him here," her escort screamed at the top of his lungs. "Why, if I hadn't found it in a bar. . . !" He dropped her in surprise. "Why are there TWO of them?"

Roxanne stared in wonder at the two individuals in the room. It wasn't the other Araso that surprised her, but the individual calmly sitting at the table. The other presence in the room, the one both Arasoes were trying to hide with their bodies—a man caught in the middle of cracking one of those hard Safehold nuts.

He was staring at her with his mouth hanging open.

"Sam Boone?" she croaked in amazement.

The first thing that Sam saw when he recovered consciousness was a Raptor's pink unwavering eye staring into his own from a few centimeters away. Seconds later Sam noticed that the reason for their unwavering stare was the Sith's being unquestionably dead. Its crushed skull was still oozing bilious fluid onto the ground near Sam's cheek. Were they both dead? Lord, he'd hate to think he'd have to go through eternity staring at this ugly sight.

Then he became aware of sounds of someone, or something, moving about. Sounds! That meant he wasn't dead, unlike the Sith.

"Good, you are awake." Sam blinked

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at the group of Arasoes standing over him. Scattered about were his former captors, all quite indisposed to life from various and summary traumas visited upon their heads and bodies. It looked as if some giant hand had ripped the three into a septet. Gruesome.

"What?" Sam began as he rose from the ground and then realized that he was quite naked. Nearby lay his coverall, ripped and splattered with blood. He quickly ran his hands up and down his body to check for any mortal wounds that might have otherwise gone unnoticed. That much gore meant something terrible had happened.

"I am sorry I hit you so hard," Burrowingtoheaven said, "but I had to knock you out of the way. It was a very near thing."

"Wha. . . ?" Sam began, trying to absorb too much data in too little time.

"We have no time to talk. Come with us. We must get you out of the way as soon as possible."

Burrowing carried Sam to speed their passage. Sam was impressed since he was nearly twice the size of the creature. Perhaps he had underestimated them after all.

In the distance there was the sound of heavy equipment being moved. "Soon, soon. Oh, it will be so lovely to use the old tools again. It's been years since we played these games, you know." Burrowing sounded positively gleeful.

Old tools? Games? Did the Arasoes have some sort of defense they were going to use against the Sith? He could imagine what pitiful sort of weapons they might have—spears and arrows, he imagined, perhaps even something as advanced as a trebuchet. It mattered little: It was going to be a slaughter, just as he had feared.

Burrowing didn't seem to realize the danger they all faced. In fact, he was humming and tootling as the sounds continued. "Won't be long before we're ready." He glanced aside and, tootling in a conspiratorial whisper, said, "They won't let us use them except for defense, you know."

"They?"

Burrowing shrugged. "The Hegemony. Ever since we wiped out those pesky Turnshekkies a few years ago we've been under Court orders to restrain ourselves except for defense. This will be a great opportunity for the kids to have some fun."

Fun? Kids? Didn't anyone on this damned planet realize just how nasty the Sith missionaries were going to be? Whatever defenses these peaceful creatures could muster would hardly . . .

A thunderous boom reverberated through the heavens. "Oh, good, they're practicing with the mass drivers." Burrowing skipped in obvious joy. "That means that the automated launchers are ready as well. Good, now all we have to do is activate the fleet and we'll be all ready for them. I do hope these Sith prove more entertainment than the Turnshekkies. I mean, all we did was knock out three of their planets and all the fight went out of them."

"They surrendered?" Sam asked.

Burrowing laughed in E minor. "Heavens, no. We just got rid of those who were left. No sense letting them have another round with us, right?"

Suddenly Sam was very afraid of these "gentle" Arasoes. Now he understood why they refused to negotiate with the Sith and why they were so helpful in hiding him and the Finger. They wanted to be sure he wouldn't screw up their warlike plans. "You *want* the Sith to attack!"

Burrowing wiggled its little tail. "Of course. We'd be fools to pass up an opportunity like this."

It was hard to think of something like a nuclear attack or battling waves of Sith warriors as recreation, but considering the dismissive way most of the Galactics treated xenocide, Sam couldn't dismiss it as impossible. Burrowing did say they'd wiped out a race or two themselves, hadn't he?

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Maybe this was what he was supposed to prevent. Although, now that he thought about it, his agent hadn't been exactly clear as to who had engaged him. Whoever it was must have been interested in keeping the war from escalating into a pogrom. Perhaps he had misunderstood his agent's instructions and it wasn't the Sith he was sent to protect!

Unless he did something, and soon, he'd probably have a seat right on the game's fifty-yard line.

The rumbling was barely noticeable at first, a trembling of the floor that jiggled the water in the dish on the table. None of the Arasoes seemed to notice, so Sam passed it off as a minor tremor, a small Araso-quake of no lasting import.

The second shock was more intense and brought his bodyguard to his feet. Something strange was definitely afoot. "What is it?" Sam asked.

"The old vaults open with considerable difficulty," Skippingalonggracefully answered after considering the sound for a moment. "I think that . . ." Whatever he thought was overcome by events as the door slammed open and a hefty Araso jumped inside screaming something about a bar and dragging a . . .

Sam could scarcely believe his eyes as the woman stood and straightened her clothing, gathering the flopping halves of her open blouse together as she stared in open-eyed amazement directly at him.

She had to be the loveliest thing he had ever seen, and blonde! All thoughts of missionaries, of his captors, of the certain death of every unconverted soul on Araso faded into insignificance as he drank in her features, her wonderful, perfect, human features.

"Are you going to say something or are you just going to sit there with your mouth open?" Roxanne said as she tied her blouse into a knot at her midriff.

"Yes," Sam said quietly and sadly as Roxanne covered two of her most prominent features.

"Yes what?" Roxanne asked.

"Whatever you want," Sam replied, wondering for a moment if the Swedish embassy had sent this vision of feminine pulchritude to him.

Roxanne scowled. "Wonderful, forty jillion light years from home and I have to run into a jerk with his brains in his pants,' she spat out. "Hello, Sam. We are in deep shit and, just in case you didn't know it, there's going to be a couple of thousand ships landing on the planet shortly and they're all loaded with really pissed-off Sith. And, just in case that isn't bad enough, unless you know something I don't, there's a Sith that would like nothing better than to turn us both into human sashimi!"

"We're safe here where the Sith can't find us," Sam replied soothingly. "Matter of fact, why don't we make ourselves comfortable for a few days and talk about our options?" Sam scooted aside to make room for Roxanne beside him on the bench.

"Would you pay attention?" Roxanne felt like screaming. She sat on the opposite side of the table where his hands couldn't reach and took the heavy nutcracker from his hands. Didn't the jerk understand the danger they were in, the danger the entire planet was in from the Sith? A few seconds later she started to feel angry. "Listen, Sam. You're the one to blame for my predicament. If you hadn't been the dirty little thief who stole the Sith's relic thing I wouldn't be here now."

Sam smiled dreamily. "Then that must have been the smartest thing I ever did, darling. Besides, I didn't steal it—not exactly, I mean, there were circumstances."

"Tell me about it," Roxanne said.

"So you see, this is all a misunderstanding," Sam concluded, but Roxanne didn't look convinced.

"Believe me, Roxanne. I'm just a victim of circumstance. I'd return this stu-

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pid thing right away, but," he nodded toward the nearby Arasoes, "they won't let me leave."

Roxanne was puzzled, not in the least by how Sam could have acted like such a complete idiot and why she felt so attracted to his disarming naivety. How had he managed to survive the dangerous and confusing Galactic environment? There must be more to him than met the eye. Maybe he had some redeeming qualities that weren't yet evident.

"I don't understand why the Arasoes are involved in this," she asked. "Why didn't they just send the Finger back to the station? Why didn't they offer to intervene on your behalf? They could say they found it or something. That would take you off the hook, at least."

"Too late for that, what with everyone so anxious to turn me into hamburger," Sam replied. "Regardless of how the thing gets returned, I'll still be the target for taking it in the first place."

Roxanne considered her options. Finding Sam alive made it likely that she could now escape with a whole skin. All she had to do was turn him in and return the Finger. While the former would be unthinkable, the latter was entirely possible. Thinking of which, she said, "Where is it?"

Sam looked blankly at her. "Where is what?"

"The relic. The artifact. The religious icon." With each syllable she rapped the table with the heavy nutcracker. "Whatever the hell this precious ancient object that is so damned important to the Sith. Where is it?"

Sam didn't say a word as he gently removed the Finger from her hand. "Guess."

"Gak!"

"Exactly my first reaction," Sam said. "Not much to look at, is it?" He held it up and turned it in the light. "I think it might have been a sword or something."

"That's pretty far-fetched," Roxanne replied. "I hardly think a star-faring race would battle with something as primitive as a damned sword."

"Maybe it's older than that—like, before they spread out into the galaxy," Sam guessed, still turning it this way and that.

Roxanne took it from him and looked closely at the handle. There was nothing she could see that might suggest it was other than Sam had assumed. The handle was mostly intact, shaped to fit a Sith's hand of course, with grooves into which their claws could curl.

She turned it to peer into the grooves, trying to find a switch or button in one that might give a clue to its operation—former operation, that is—but again, there was nothing to see.

Turning her attention to the other end, she examined the melted blob that started a few centimeters from what remained of the handle. The surface was mirror smooth, as if the entire weapon had been held in a zero-gee furnace until it was completely melted. There were the pieces of shell smashed on its surface, evidence of its most recent utility.

She placed it back on the table. "Beats me," she said. "For sure, the thing doesn't work any more." She thought for a moment. "Sam, what if I took this back to them and said I found it among your possessions? Both of us would be out of it then."

"The Sith might not believe you found me, and kill you on the spot. On many spots, in fact." He reached across the table and patted her hand. "Your death would be terrible, a massive loss for humanity, not to mention that it would break my heart."

Roxanne drew her hand back. The more she became involved with Sam the greater the likelihood that she'd share his fate. No, she had to get the Finger back to Flenser so she could get the hell away from Safehold before the slaughter began.

Sam continued to talk. "Even if they believed you, I'd still be at risk. The second I try to leave this planet both of our

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stories would fall apart and we'd end up as Sith sashimi. No thanks; we have to figure out how to get this thing back to them *and* save our skins.

"Besides, the fate of either of us, regardless of our personal views, is minor in comparison to what is about to happen."

"I know," Roxanne replied. "These poor little things."

Sam grimaced. "Compared to them the Sith are kittens." When she looked puzzled Sam explained what he had learned about his hosts. "So you see, we have to figure out how to stop the war."

The more Sam thought about it the worse the situation seemed to be. One of the Sith delegation, Bowelsplitter most likely, wanted the Finger back so he could lead his bloodthirsty missionaries. Without the authority of the artifact he had only his formidable strength to rely upon. That must mean he was only capable of intimidating the delegation and not the rest of the Sith population on the station.

Was there another Sith who would be a better choice for leader? Thus far all of them seemed equally combative and too willing to inflict damage on anything that stood in their way. In fact, he doubted that anything except overwhelming strength would convince them to change their approach to devastate the Arasoes.

"We've got to get out of here," Roxanne hissed with her hand firmly over the translator's microphone so that the guard would not understand.

"Tell me," Sam asked absently. "Why did Bowelsplitter ask you to find me?"

Roxanne looked startled. "Bow—what? I don't know who that is. The one that threatened me was named Flenser," she stumbled over the sibilants, mistaking an *hsht* for a *shht,* but Sam knew who she meant.

"So the second in command has pretensions," Sam mused. "Well, well. How interesting."

There was a dull thud and the sound of something hitting the floor. Sam looked over to see one of his captors sprawled out. Roxanne stood over him, Finger in hand.

"Come on, damn it. If you're going to pull a freaking rabbit out of a hat now is the time to do it." Without another word she raced out the door. Sam was a bare second behind.

The Arasoes they ran into seemed unperturbed by the preparations. In fact, there was a festive feeling in the air. They passed a family carrying an arsenal of wicked weapons. The kids were carrying missiles for their parents with broad smiles on their faces. Sam was particularly intrigued by the baby's rocket launcher rattle. "Can I shoot one, dad, huh, can I, can I?" pleaded the eldest child.

Elsewhere, heavily armored vehicles were coming out of the vaults below the surface, each one festooned with bunting and a dozen or more celebratory passengers.

"I don't feel good about this," he said.

They made their way to the spaceport. Sam hoped that they could find a shuttle to the station so he could plead his case with the remaining Sith before Bowelsplitter found out. Maybe, just maybe, before they chopped him up, he could pound some sense into their heads. Maybe with the Finger.

"Uh-oh," Roxanne said when they turned a corner.

Twenty meters in front of them was the entire Sith delegation and a few highly painted individuals Sam had not seen before. These each sported armor and a sidearm. "It looks like the fleet's arrived," he gulped.

Between the Sith and their current position was the Araso delegation, Hopper in the lead.

"By the Universal Great Egg," Bowelsplitter proclaimed, "do you repent your uniformed ways and pray allegiance to

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the Egg Alliance? This is your last chance to save your souls."

Hopper was jumping up and down. "State the rules, state the rules so we can begin."

"This is not a game, infidel," the armed missionary on Bowelsplitter's right screamed, and hissed an insult too vile to translate. "We are here to fulfill the orders of the Great Egg." He looked at Bowlsplitter. "You do have the symbol of leadership, don't you?"

Bowelsplitter spoke again. "With a single command I can call the entire fleet down to decimate all who do not understand the gentle wisdom of the Great Egg. We will strafe your towns with aircraft. Our infantry of acolytes will march through your population to administer blessings and kill the unfaithful. We will poison your air and desecrate your fields."

He might have continued in that vein for a while if Hopper hadn't interrupted. "No poisons," the little being insisted. "The rest is all right though." He hesitated. "You won't mind if we used a few nukes, would you? They make such a nice display."

The missionary whipped out his sidearm so quickly that Sam missed it. "Do not mock our holy campaign," he hissed as if the steam valve had been stuck on open.

"Wait, wait," Sam screamed and raced forward waving the Finger above his head. "There's something you have to know."

Three of the Araso delegation dove for Sam while Bowelsplitter and Flenser raced forward, all aiming to intersect on the exact space Sam assumed he was going to occupy for the rest of his short life.

CRACK! The roar of the missionary's sidearm was deafening. "The starting gun?" Hopper asked gleefully while pulling an automatic blaster from his pouch.

"Desist!" the missionary screamed. "The Finger must not be harmed." The two Sith hesitated, but only for a moment before they both leaped at Sam.

Sam gripped the handle and swung wildly, hoping to buy a few precious seconds. He tightened his grip and . . .

ZZZZT! Twin rays of intense light shot from the mirror finish of the Finger and stuck Flenser and Bowelsplitter with explosive effect, sending both to the ground. The end of the Finger was glowing white-hot.

Sam realized that, somehow he must have triggered the Finger's energies. He pointed the weapon at the missionaries. "Stop," he shouted.

The missionaries were rigid, their mouths open in shock. "He fired the Finger!" they screamed. "It's not supposed to do that."

"There isn't going to be a Sith victory," Sam shouted as he tried to steady his aim at them while simultaneously trying to figure out how he'd made the thing fire. "In fact, I was coming to warn you that the Arasoes just might wipe out your entire race." Very briefly he enumerated the multiple weapons the Arasoes were amassing and their brutal history with the Turnshekkies.

"Blasphemy!" screamed Bowelsplitter. "Nothing can be greater than the faith of the Universal Great Egg."

Flenser turned slowly to face Bowelsplitter. "That's just like the rest of you Universalists. You're nothing but bloodthirsty orthodox fools. Why are you afraid to accept a more liberal interpretation of the faith?"

Bowelsplitter crouched in attack mode. "I will not tolerate a member of some crackpot denomination in my cadre. Accept the teachings of the Universal Great Egg or die."

One of the missionaries spoke to Flenser. "Are you too a member of the Enlightened branch?" When Flenser nodded agreement the missionary drew his weapon and pointed it at Bowelsplitter. "Celestial group, I suppose," he stated while taking careful aim.

"Why, no," Flenser replied. "We are of

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the Revised persuasion."

"Revisionist heretic!" the missionary yelled and swung the weapon to back bear on Flenser.

At the moment Sam was sure Flenser was going to be immolated, the other missionary struck the gun away. "Don't waste your time on a bunch of stinking Revisionists. Bad enough that we find some stinking alien waving a phony Finger. Come on, let's tell the troops it was a false alarm or something."

As the two turned to go, Sam heard one say, sotto voce, "Universalist and Revisionist jerks. Who'd ever think they could do anything without screwing up?"

Bowelsplitter and Flenser watched the receding backs of the missionaries. All of the fight seemed to have gone out of them.

"Apostate," said Bowelsplitter, but with less force than before.

"Don't call me that, you orthodox scum," replied Flenser.

"People," Sam exclaimed inappropriately. "Need I remind you that I have the Finger?" He pointed it at the pair and wondered how he had managed to get that thing to fire earlier. "Need I remind you that only I know how to work this mighty weapon?"

"It's a melted sword, for Egg's sake," Bowelsplitter spit. "Besides, we only wanted to use it to convince the missionaries that we had the authority of the faithful."

"If it isn't an important religious artifact," Roxanne asked, "then why did you want me to track it down?"

Flenser shrugged. "I just wanted to make certain it didn't make these orthodox idiots look legitimate to the rest of the Sith. The holder of the Finger does have the power, regardless of how misled they may be." He paused. "I just can't understand how an idiot like Ripgut managed to get hold of it."

Bowelsplitter cleared his throat. "He didn't. Ripgut lied about the Finger when he couldn't get anyone to believe he could bring about another conversion. He had to steal this replica from a museum to organize the delegation."

"Urk," Sam said. "Well, how did it fire then?"

Hopper shook his head sadly as he walked up to Sam. "I knew I should have tried to shoot you instead of that thing. You've ruined the game, you know. If I wasn't a good friend I'd fry your ass for that."

"I think we'd better grab a ride on the shuttle," Roxanne suggested. "Quick, before he changes his mind."

Two days later Sam had completed the negotiations attendant to establishing the Newly Reformed branch of the Universal Revised Sith delegation. This unfortunately involved ceremonial acts involving blood, more blood, assorted curses, a nice pastry tray, and less than mortal combat between Bowelsplitter and Flenser, the two contenders for deacon. "They actually wanted to kill each other," said Eviscerator, the new priest of the branch, "but thought the artistry would probably be wasted on you."

Sam was relieved when the service was complete and thankful for the honor guard of Sith to protect him from the wrath of the highly irate Arasoes. He appreciated that much more than the few billion glizzintia the Sith paid for averting disaster.

Roxanne's reward for finding Sam had been less, but still enough to afford a first class berth on a departing liner.

"So, where are you going now?" Roxanne asked as they strolled to the neutral departure lounge.

"My agent wants me to head out to Bingnagia. Something to do with real estate, I think. I must admit that, for more than one reason, I'll hate to leave." He smiled at her and was encouraged by her response. "Is there anything we might do in our remaining time?" he ventured hopefully. He looked around for someplace private, although in this alien setting they could probably do any-

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thing in plain sight without arousing interest.

Roxanne cooed and brushed his cheek with the back of her hand, stroking it from ear to chin. "You are such a dear, Sam. I know, since we'll be waiting a few hours we could play a little game of cards," she suggested shyly. "It'll help us get to know one another a little better, don't you think? Maybe we could even play poker for some of this money we've just gotten."

Sam couldn't resist her smile, although he doubted she knew what she was going to be up against. He'd go easy on her and let her win a few hands to start. After all, he wouldn't want to get on her bad side—not that she had a bad side, come to think of it. "What do you think would make it interesting?" he asked with a smile.

Roxanne smiled back shyly. "Oh, I don't know, Sam. Why have limits at all?" she ventured. "I'm sure I can trust you." ⚄

(EDITOR'S NOTE: Sam Boone appeared earlier in "Sam Boone's Super Fantastic Intragalactic Ass-Kickin', Body-Slammin', Foot-Stompin' Rasslin' Extravaganza" [May 2002] and many more.)

Success is paralyzing only to those who have never wished for anything else.

—Thornton Wilder

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Cauldron, Jack McDevitt, Ace, $24.95, 373 pp. (ISBN: 978-0-441-01525-2).

Victory Conditions, Elizabeth Moon, Del Rey, $26.00, 400 pp. (ISBN: 978-0-345-49161-9).

War World: The Battle of Sauron, John F. Carr and Don Hawthorne, Pequod Press, $45.00, 444 pp. (ISBN: 0-937912-04-2).

The River Horses, Allen Steele, Subterranean Press (500 copies, numbered), $35.00, 119 pp. (ISBN: 978-1-59606-132-3).

The Sagittarius Command, R. M. Meluch, DAW, $23.95, 357 pp. (ISBN: 978-0-7564-0457-4).

This Is My Funniest 2, Mike Resnick, ed., BenBella Books, $14.95, 410 pp. (ISBN: 978-1-933771-22-9).

The Complete Guide to Writing Science Fiction: Volume One: First Contact, Dave A. Law and Darin Park, eds., Dragon Moon Press, $24.95, 320 pp. (ISBN: 978-1-8969-4439-5).

Energy Victory, Robert Zubrin, Prometheus, $25.95, 336 pp. (ISBN: 978-1-59102-591-5).

Jack McDevitt's Priscilla Hutchins series—*Engines of God, Deepsix, Chindi, Omega, Odyssey*—has given us a future of wonders. The galaxy doesn't seem to have many intelligent species around, but there are remnants and ruins (some of them due to the depredations of the omega clouds, mysterious constructs that zero in on collections of straight lines and right angles—cities, in other words—and blast them with lightning). Humanity has managed to ward off the threat once, but, that done, it must deal with its own problems, many of which are environmental in nature. Space exploration is expensive and dangerous. Politicians argue that the money can be better spent at home. Funding for space exploration withers and dies. And by the time of **Cauldron**, Priscilla's beloved Academy is dead. Priscilla is a fund-raiser for its heir, the Prometheus Foundation, which still supports a pair of ships. The star pilots who used to run a larger fleet have moved on to other things. Matt Darwin, for instance, is selling real estate.

One of the remaining ships discovers a derelict a billion years old, with an omega cloud bearing down on it. The crew exploring the derelict pushes their luck and the cloud blasts the ship. Nobody dies, but now there is only one ship left for the exploration program and no money to buy more.

The situation is sad, deliberately and poignantly reminiscent of the way we abandoned the Apollo program, turning the budget to more mundane uses, turning society's focus inward, forsaking the dreams that nourished a generation of scientists, engineers, and science fiction fans, including McDevitt and myself and a fair number of you. Perhaps you have wondered how the situation could be turned around. So have I, and I have seen no real answers that would work in the real world. But McDevitt writes fic-

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tion. His answer begins with an alternative to the standard Hazeltine FTL drive. It's strictly theory, experiments have not been promising, and its developer is dead. But here comes that developer's assistant, Jon Silvestri, with word that he has been working on the drive, it will be many times as fast as the Hazeltine, and he thinks it will work. It just needs a test.

Alas, the first test is a disaster. But Matt Darwin thinks Jon deserves another chance. He resurrects a lander parked in front of an elementary school, gets Priscilla to help raise funds, and . . . You guessed it. It works. It's faster by a long shot. And when they install it in a real ship, not just a lander, they can take off on a test run far beyond the bounds of all previous exploration, all the way to the center of the galaxy where in the chaotic swirl of dust and radiation around the central black hole—the Cauldron—lies the source of the omega clouds. They make a few stops—and interesting discoveries—along the way, and when they get there . . . What can I say without saying too much? The omega clouds exist for a reason, but not one that has been mentioned before in the series, nor one that anyone other than Jack McDevitt would come up with. That aside, the case has been made. Star travel is now cheaper and faster. Society's focus can turn outward once more while the pioneers retire to porch rockers. And the Space Age is safe, at least for a while.

If only there really were a Jon Silvestri. The pages of this magazine have over the years contained a number of stories and articles that said space travel as we know it *is* expensive and what we need is a faster, cheaper way of getting into orbit and beyond. A number of solutions to the problem (space elevators, anyone?) have been suggested, but none have been built. I would love to believe that if one had, the future of which we have long dreamed would be upon us. But there are indeed many domestic demands—wars, disasters, entitlements—on the budget. It will take a lot more than an improved space drive to get us out there for real.

McDevitt is more optimistic. He is also quite thoughtful and he has not forgotten how to give us a good read. So don't let this one slip past you.

Elizabeth Moon introduced Kylara Vatta in *Trading in Danger* (reviewed here in March 2004) as the sturdy, independent, spirited daughter of a major trading clan. Booted in disgrace from the military academy, she hied off with a decrepit spaceship only to become a privateer when, in *Marque and Reprisal* (January/February 2005), most of the Vatta clan back on Slotter Key was destroyed and the interstellar communications network of ansibles crashed. In *Engaging the Enemy* (September 2006), she tried to form a force that could fight the pirate fleets, but with only partial success. By *Command Decision* (May 2007), she had a tiny fleet and a rapidly growing reputation. Meanwhile, the disreputable Rafe, scion of ISC, the company that ran the ansible network, had returned home to find his family kidnapped and both ISC and his world's government weakened by corruption and treason; house-cleaning was in order, and he had to become a respectable executive even though he would rather be with Ky.

The popular series concludes with **Victory Conditions**. Ky is now the admiral of a growing fleet, but the pirates are about to raid a shipyard and steal a navy. She is suppressing her pining for Rafe even as she runs into people who think she's just a girl and therefore cannot possibly be ruthless enough to be admiral. Meanwhile, Rafe is dealing with charges that he is far too cozy with Ky and Vattas are really the ones behind the current disaster. And the pirates . . . Ah, they're clever fellows who think far ahead. But they can't outthink or outfight Admiral Vatta. The novel's real question is

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whether the fates can keep Ky and Rafe apart!

Victory has all the action we have come to expect from Moon, but where in the earlier volumes the romance was more subliminal, now it's obvious. And the result is a very satisfactory conclusion to the series.

Some two decades ago, John F. Carr and Jerry Pournelle created the War World series. Carr is now (according to his web site, www.Hostigos.com) embarked on a series of anthologies putting the various War World stories in chronological order, with *War World: Beginnings* due soon. Far in the future the Empire of Man faces secession by many worlds, led by Sauron, home of specially bred super-soldiers. There is war in which the Saurons display their talents and bleed the Empire nearly dry, until the Empire mounts a final assault that sterilizes Sauron and leaves one single Sauron ship fleeing for safety. It winds up at Haven, a rugged world for rugged folks (the Empire long used it as a dumping ground for criminals and assorted other scum) that has bred a very tough people, often used as the Empire's best troops. But the Empire is in decline, and its forces have abandoned Haven to its own devices. It is descending toward a lower level of civilization when the Saurons arrive, bent on quashing all resistance, taking over, and using the local women to breed more Saurons.

In **War World: The Battle of Sauron**, portions of which appeared in the first two *War World* anthologies in 1988 and 1989, John F. Carr and Don Hawthorne lay out the final battles, the loss of the Sauron home world, and the heroic innovativeness of Sauron leader Galen Diettinger. It is marred by a few technical gaffes (if you keep accelerating, you do not pull more gees as time goes on; you just go faster), but on the whole fans of action-adventure will not be disappointed. And when the Haveners get in a few good punches at the super-soldiers, the future development of Haven into the War World of the series begins to seem inevitable.

Aside from plot, the novel is marked by a curious ambiguity. It begins by showing the Empire as declining, corrupt, on the verge of civil war sparked by rival claimants to the throne. But those who lead the troops are canny and forethoughtful, loyal in a way that politicians are not, and when Colonel Cummings is promoted to general and sent to Haven to maintain a mere militia as the Empire abandons that world, it may look like a sacrifice play, but there is clearly nobility here, and high purpose. It seems obvious that Cummings must have an important part to play—but not right away, for now the authors focus on Diettinger. His people are ruthless, even cruel by "civilized" lights, but they too are loyal to something higher—not an empire, but the Race—and Diettinger too is a noble soul, a hero in defense of his people and its destiny. These are men of military virtues, and it is not hard to imagine that sometime in the future they must make common cause. But that future is not in this volume, for at its end Cummings and Diettinger are, in effect, glaring at each other from opposite sides of the arena. One is confident that he has won. The other is planning his next blow. Both know the other is someone to admire.

But which one is the hero? We expect there to be one, and we don't expect authors to suggest that the hero is the one who views ordinary folks as "cattle" to be used as wombs for his race. But Haveners can be pretty bloody-minded too, and neither Cummings nor Diettinger knows that Haven is about to become War World.

Allen Steele's Coyote series has proven popular and open-ended enough for him to stop using "Coyote" in the titles (I reviewed *Spindrift* last November). It began when refugees from Terran tyrants colonized the world of

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Coyote and began to forge a new life, only to be interrupted when the tyrants, or their successors, came after them. Rebellion soon put a stop to that, and soon the colony was bigger and better than ever, with an alien visitor promising to open the stage much wider. In the nature of such series, much happens offstage, which gives an author the opportunity to write a host of interstitial tales, some of which may even be entire novels (as was *Spindrift*).

The River Horses is a smaller story, a mere novella. It tells what happened when Marie Montero and Lars Thompson, veterans of the rebellion and now rather given to raising hell, are banished from the colony, given six months to explore the wilderness and—with luck—get their acts together again. With them, as a guide, goes savant (human downloaded into a robot body) Manuel Castro, a leader under the human tyrants, now an object of scorn and hate. Three misfits, a fair amount of anger, and one sad case of testosterone poisoning that soon sends Lars off with a crew of drunks while Marie becomes a pillar of a budding community and comes to realize Manny's true humanity. The title (and the cover art) has to do with the trouble Lars gets into with his new friends, forcing Marie to come to the rescue.

It sounds good, doesn't it? But it is not one of Steele's strongest stories. He goes to great lengths to affirm the values of independence, solidarity, and humane respect. Granted that in a society built on such values there must always be a few who do not share them, I would expect those few to have a difficult time of getting their way. But here they have far too easy a time of it. Marie's independence is violated, her humanity is not respected, and she is enslaved to a kind of respectability—partly in the name of a different sort of solidarity—that seems quite out of place.

I am being deliberately ambiguous because your mileage may vary and I'd hate to spoil the story for you.

According to R. M. Meluch, when Earth got FTL travel, the descendants of the ancient Romans emerged from their secret niches as doctors, lawyers, priests, and all the rest who just happen to know a bit of Latin and hied off to Palatine to found the new Roman Empire, thoroughly elitist, thoroughly tyrannical, and absolute anathema to the U.S.A., which has the clout back home—except for the League of Earth Nations's (LEN) multicultural diversity nuts, who are absolutely sure that if everyone would just sit down and talk . . .

Well, maybe. But as soon as someone invented the res FTL communications tech, using it turned out to be ringing the dinner bell for the Hive, vast swarms of insectoid space-dwellers that loved to eat everything in sight. So meet Captain Farragut of the *Merrimack*, who seems to have a talent for surviving Hive attacks and inspiring loyalty and in volume two, *Wolf Star*, hauled enough Roman chestnuts out of the fire to convince them to surrender to him. As volume 3, **The Sagittarius Command**, opens, he's fighting the Hive again, for they have suddenly appeared on a Roman world that was once home to a Roman megalomaniacal genius. Once the Roman patterner Augustus comes back into the picture and the CIA shares a bit of intelligence, that genius is suddenly suspect. He may not be as dead as reports would have it! Is he responsible for the Hive and its attacks? It's time to go see, and the *Merrimack*—with enough other ships to make up a task force—is off toward Sagittarius to investigate.

The tale is marked by continuing U.S.-Roman rivalry, an Imperial assassination, Lieutenant Colonel TR Steele's still-stifled yen for the delectable and heroic Kerry Blue (until . . .), and a whole lot more of Farragut's down-home brand of leadership.

Still pure space opera, complete with

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deuses popping out of machines just in time. Still good fun.

As Mike Resnick assures us in his introduction to **This Is My Funniest 2**, "science fiction writers like to laugh." Therefore they write funny stories. Some writers do it often. Some do it rarely. But all of them (okay, most of them) do it.

Resnick took advantage of this truism a few years ago to publish *This Is My Funniest*, an anthology of stories which various writers assured him were their funniest, or at least their favorite funny. It was enough of a success to justify a sequel, with an almost entirely new roster, including Ron Goulart, Mercedes Lackey (who insists that an alien puppy ate her pickup), Janis Ian, Jack Dann, Gregory Benford, Michael Bishop, Tony Lewis, Larry Niven, and Resnick himself. Some are truly funny, some are no more than amusing, but if I try to put them in lists for you, you will disagree and be just as right as I am, since humor is very much a matter of taste. Sometimes bad taste—as in Tony Lewis's tongue-in-cheek suggestion on how to handle inner city issues.

Ever had the feeling that you too could write science fiction? If so, you've then wondered what to do next. My own answer is: Read SF, read more SF, and read some more SF. Then siddown, write something, and try to figure out what's wrong with it by comparing it with the sort of stuff you've been reading, letting friends tell you what they think, or even by exposing it to one of the few remaining magazine editors in the field. Pay attention to what you learn in the process. If you follow my advice, you may not need to hunt down the best possible how-to-write-SF book, an impossible task given how many such are out there, every one of them with its fans. You don't need to worry about the history of SF, or a definition of SF, or a list of all the subgenres of SF.

Which—of course!—is exactly where **The Complete Guide to Writing Science Fiction: Volume One: First Contact** begins. So start with Chapter 5, with Wil McCarthy talking about the place and use of technology in SF. Other contributors—of whom Piers Anthony and Orson Scott Card are surely the most famous—deal with world building, plot, clichés, characters, and so on. Despite the book's beginning, there is good advice here, and it may be useful when you are trying to figure out where you went wrong. Whether you need that advice to start writing SF is a different question.

According to Robert Zubrin's **Energy Victory**, by continuing to rely on petroleum and send great gobs of money to Saudi Arabia, the U.S. is financing its own destruction. The money drains the economy and goes to fund the spread of Islamic extremism and terrorism. Despite an early warning with the 1973 oil crisis, the U.S. "political class" has done nothing to stop the process, partly because they are in the pockets of the Saudis. If we could only free ourselves of dependence on oil, we could strike a blow to the hearts of our foes!

Of course, Zubrin has an answer. He argues at length that biofuels (particularly alcohols derived from various crops) combined with flex-cars (which can burn gas or alcohol in any mixture, depending on what is available) will do it. At the same time, a crop-based fuel system holds the potential to jump-start development in many poor countries.

This is sensible enough, but the argument is spoiled by the emphasis on political conspiracy, which makes the whole sound more like a rant than a prescription for change. It is also weakened by Zubrin's failure to mention "peak oil," the imminent moment when the oil supply begins to decline; oil-dependence is a time-limited thing, which means that there is another reason to develop alternatives, preferably before the

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crisis. Another omission is that though Zubrin mentions the unavailability of new farmland, he does not mention the effect of heavy reliance on biofuels on soil fertility, erosion, food supply, and food prices. Other commentators are more thorough, noting that because U.S. farmers can make more money with fuel crops, the price of grain and other commodities is already rising, to the detriment of the world's poor (see, e.g., Robbin S. Johnson and C. Ford Runge, "Ethanol: Train Wreck Ahead?" *Issues in Science and Technology*, Fall 2007).

Are there other solutions? Zubrin mentions the need for expanded use of nuclear power but ignores the potentials of solar power satellites, which may be expensive but offer additional benefits in the form of expanded presence in space. There is also some interesting work being done in the development of supercapacitors, which offer the ability to store large amounts of electricity more conveniently than do batteries.

Investing in any of these technologies also diminishes oil dependence and reduces the flow of money to terrorist states and groups. It could also provide technological products for U.S. industry to sell abroad, which would strengthen the economy. ■

Everyone is a prisoner of his own experiences. No one can eliminate prejudices—just recognize them.

—Edward R. Murrow

The unleashed power of the atom has changed everything save our modes of thinking.

—Albert Einstein

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BRASS TACKS

Dr. Schmidt,

I cannot understand how you keep publishing the idiotic stories by Barry Longyear on Jaggers and Shad. I have been a subscriber for twenty years and these are the only *Analog* stories that I skip reading. I understand people have different tastes: ask your readers what they think about them. I bet most share my feelings.

Sincerely,
Bruno Loran, PhD

Thanks for your comments, but actually, I believe you're the only reader who's said he disliked those stories. Many have said they love them, and the first was voted Best Novella for the year in which it appeared.

Dear Stan,

This year [2007] has been so-so, but the November issue was great: every story in it was excellent! I particularly like the Jaggers & Shad stories—the concept is a great one, and I hope to see more . . .

Alan Batie

Dear Editors,

My husband and I used to think we didn't care for short SF, but two things changed our minds. First, my husband lost a lot of his vision and now qualifies for the Library of Congress recorded books. You provide *Analog* free for people like him, so he started getting it to increase the amount of SF he can read. He discovered some good stuff! Then we went to WorldCon in LA, and at a booth I subscribed to *Analog* and *Asimov's,* more as a way to thank you both for letting him have the magazine free than for anything else. Now I am hooked!

The quality of what I am reading is great! I just have one suggestion for how to improve your magazine. I often encounter authors I had not heard of before (like Robert Chase, whose story "Domo Arigato . . ." *really* impressed me!), and I don't know if they are new, short fiction writers solely, or whether they have novels (still my preferred reading). I have to go Google them to find any information, which is a nuisance. *Asimov's* is better than *Analog* in providing some background author information. I'd like to see *Analog* do that.

By the way, I also really like the editorials. I often want to pull them out to send to my local elected officials or other appropriate people!

Angie Boyter

Dr. Schmidt,

One of the most debated subjects today is climate change. You've addressed a number of aspects in your editorials. I'm not arguing with anything specifically, but I have my own two cents, if you will indulge me.

Skipping my own opinion in the debate, I think the whole debate is actually distracting us from some very basic things.

Would anyone argue that we shouldn't be working hard to reduce pollution? All pollution, from all sources. Would

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anyone argue against greatly reducing the amount of stuff that goes to landfills? Would anyone argue against all efforts to eliminate toxins released in the environment, and cleaning up past toxins? Would anyone argue against improving the environment, fixing what's been damaged and trying to avoid future damage?

I could go on and on. The point is, the climate change debate seems to get stuck on who's to blame and the actual, real cause. Seems to me, instead, the question should be what we can do to improve things.

Let's not worry about who's to blame or worry about getting the exact, precise cause. Let's just work generally on stopping the bad stuff and doing the good stuff.

This bypasses such questions as "What is causing climate change?", "Is it human caused?", or even "Is there climate change?" What is plain to anyone with any intelligence at all is that humans have a huge impact on this planet. If we don't reduce the negative aspects as much as we can, the planet will inevitably become very unpleasant

I dunno, too simple?

Kimball Hawkins
Clearwater, Florida

A nice sentiment, but unfortunately, yes, it is too simple. The problem is that it isn't always easy to determine what is the "good stuff" and "bad stuff."

Dear Mr. Schmidt,

I read with interest your recent *Analog* editorial (January/February 2008), regarding synopses and recaps in television programs. I agree with your conclusion that they may encourage short attention spans and foster growth of a populace that cannot make its own decisions. However, I would pose another possible reason recaps and synopses have become prevalent (beside the obvious lack of program content).

I am a "channel surfer." I switch from one program to another (and often to a third when possible) and am usually able to maintain the thread of each program's plot thanks to the recaps. My viewing preferences lean toward science, engineering, science fiction, and nature programming, although I also enjoy an "evening soap" or situation comedy.

Why do I "channel surf"? The answer is simple. When I sit down in front of the television, I want content, not commercials. I do not like commercials. Most are condescending, insulting to a person's intelligence and common sense, and are often morally objectionable. I find that most commercials drive me away from advertisers rather than toward them.

(I point out a particular cellular telephone company's current ad where a father, while handing new cell phones to family members, in one-on-one situations, tells each that they are his "number one." Then, while walking away alone, takes out another new phone and says to himself, "saving the best for numero uno." This sort of attitude is prevalent in many television commercials and I find it rather repulsive and morally bankrupt. The fact that some executive at the cellular phone company approved this advertisement, and the networks didn't have the backbone to say no, is a sad commentary on our culture.)

It is because of this that I tend to switch channels when a commercial break occurs. If the timing is right, the program on another channel is in progress and I can quickly determine where the plot line has gone since I last viewed the program. The fact that so little new content occurs between commercials makes it easy to follow two and sometimes three shows at once. (It does, however, drive my wife a bit crazy.) I usually have a "backup" channel ready if the first channel I switch to is also in commercial break. By changing the order of switching, I am often able to follow three different programs. (This

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is when my wife gets up, makes some tea, and goes off to a quiet place to read a book.)

You may ask why I don't simply get TIVO or DVR from my cable company so I can record preferred programs and watch them at my leisure. I could fast-forward through the commercials and recaps and cut that 30-minute show down to the approximate 20 minutes of actual content. An hour program might actually be viewed in about 40 minutes. The answer is that I do not have that much leisure time to watch previously recorded programs. I have, on occasion, recorded a show I was unable to watch when initially broadcast. Unfortunately, I rarely get the time to watch the recording before the next time the program is aired or I learn the outcome of a recorded sporting event and loose the desire to watch a show when I already know how it ends. For me, it's either now or never. And I suspect I'm not alone.

For a while, some cable companies provided the ability to fast-forward through recorded commercials (TIVO/DVR) or even not record them at all. Recent or pending new features will no longer allow you to fast-forward through a recorded commercial[1]. This is akin to the "FBI WARNING" at the beginning of a DVD when the fast-forward function of your player is disabled.

Do you remember the advent of "pay TV"? Was it not supposed to be commercial-free television; was that not the hook that made it so enticing? The concept was you could watch over-the-air commercial broadcasts or you could pay a monthly fee to watch commercial-free programming. We all know that didn't last long. Cable subscriptions couldn't fund many popular shows which, in turn, gave rise to independent programming. When some of the independent shows gained popularity, the cable television providers went to the advertisers and showed them the "captive audience" numbers. The rest is history. (I am old enough to remember that FM radio started out the same way.)

Television and the internet are about to become more tightly entwined (using high-speed internet connections to download movies and programs to TIVO/DVR to reduce or eliminate the need to upgrade existing cable delivery infrastructure); networks are seeking new and inventive ways to hold on to ratings. Advertisers and cable television providers are finding new ways to influence our spending—sponsor products embedded in programs, interactive commercials, on-demand premium channel additions, etc.

Why do so many network programs have recaps and synopses? Is it possible that the networks realize channel surfing is a common practice? Is it possible they want to make sure we keep coming back to watch their shows? They must know we don't always get the timing right when switching channels, that we still see a fair number of commercials. The networks need to keep their numbers up so they can charge huge amounts of money for commercial slots in their programming. Perhaps it isn't only because viewers may have short attention spans or are unwilling or unable to follow lengthy or complex arguments. Maybe it's the networks trying to retain their audience. Could it be that we, the viewers, are actually the cause? I'll know I'm wrong if all the networks start synchronizing their commercial breaks.

Regards,
R. Cimino

[1] "Watch it *your* way," Andrew D. Smith, The Dallas Morning News, page 1D & 5D, 12/26/07

I did mention channel-surfing, but you have a different perspective on it. Personally, I hardly ever surf; I only watch television when there's something I actually want to see. That happens so seldom that when it does, I want to get my "money's worth." ■

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UPCOMING EVENTS Anthony Lewis

3–6 July 2008
WESTERCON 61 (West coast science fantasy conference) at JW Marriott Resort, Las Vegas, NV. Writer Guest of Honor: Kage Baker; Artist Guest of Honor: Lubov; Fan Guest of Honor: Milt Stevens. Membership: $60 until 28 April 2008. Info: http://www.westercon61.org/, Westercon 61, 6 Chartiers Court, Henderson, NV 89052.

10–13 July 2008
PORTUS 2008 (A Harry Potter Symposium) at Hilton Anatole, Dallas, TX. Membership: 1 February to 31 May 2008 $220.00; 1 June to 30 June 2008 $240.00; at the door $260.00. Info: http://www.portus2008.org/.

11–13 July 2008
OSFest '08 (Nebraska SF conference) at Comfort Inn & Suites, Omaha, NE. Writer Guest of Honor: Aaron Allston; Artist Guest of Honor: Mike Cole; TM: Rusty Hevelin. Membership: $40 until June 30, $50 at the door. Info: www.osfes.org/osfest.htm; webmaster@osfes.org; OSFest '08, 7934 Grover Street, Omaha, NE 68124.

25–28 July 2008
CONFLUENCE 2008 (Pittsburgh area SF conference) at Doubletree Hotel, Pittsburgh Airport, PA. Guest of Honor: Joe Haldeman; Critic Guest: Kathryn Cramer; Featured Filker: Lord Landless. Membership: $35 until TBA July 2008, $45 at the door. Info: http://parsecsff.org/confluence/, Confluence, P.O. Box 3681, Pittsburgh, PA 15230-3681; (412) 3440456

1–3 August 2008
DIVERSICON 16 (Multimedia conference) at Holiday Inn Metrodome, Minneapolis, MN. Guest of Honor: Anne Frasier; Special Guest: Nnedi Okorafur-Mbachu, Ph.D. Membership: $25 until 15 March 2008, $30 until 14 July 2008, $40 at the door. Info: http://www.diversicon.org/, diversicon@gmail.com, PO Box 8036, Lake Street Station, Minneapolis, MN 55408-0036

6–10 August 2008
DENVENTION III (66th World Science Fiction Convention) at Colorado Convention Center, Denver, CO. Hotels include Adam's Mark (party hotel), Hyatt Regency. Guest of Honor: Lois McMaster Bujold; Artist Guest of Honor: Rick Sternbach; Fan Guest of Honor: Tom Whitmore; TM: Wil McCarthy. Membership: (until further notice; see website): USD 175; supporting membership USD 40; child (until 12 as of 6 August 2008) USD45. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Nominate and vote for the Hugos. Info: www.denvention3.org; president@denvention.org. Denvention 3, Post Office Box 1349, Denver, CO 80201 USA. ■

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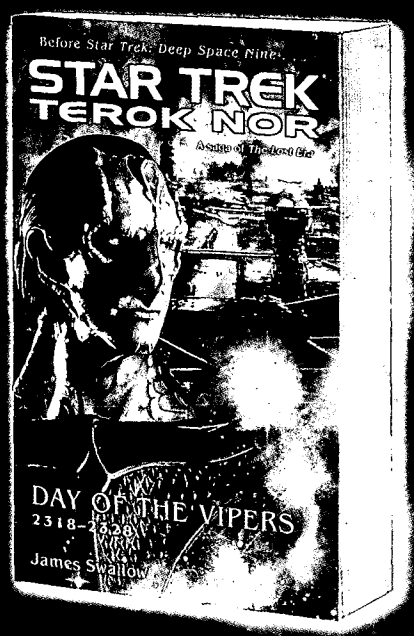

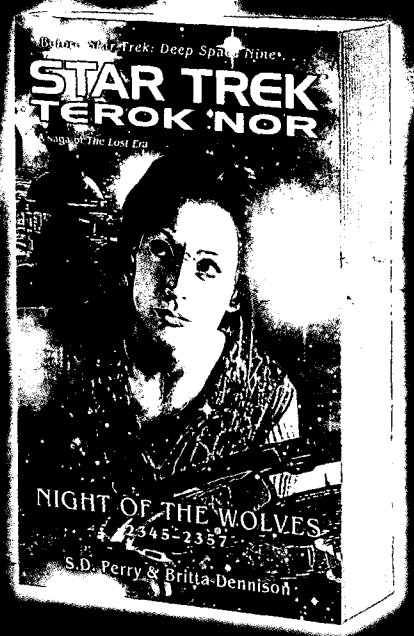

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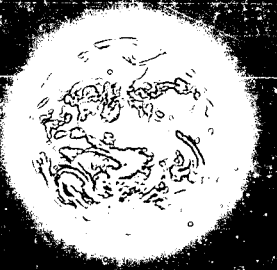

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